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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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S——.

ALTHOUGH it is contrary to the principles of wisdom to set bounds to the results which are to be achieved by scientific research, yet where science and commerce have much in common it is desirable to discuss limitations, and to consider where the line should be drawn between what is possible and what is merely probable. Wireless telegraphy is a case in point. We have all followed with zeal the growth of this method of communication; and as regards the discoveries upon which it depends, we have sought to give honour to whom it was due. Now that it has passed the transition period, and has developed into commercial proportions, equal justice must be done to the public as to the inventors. While we have our own opinions as to the validity or otherwise of the radical patents, we desire nothing better than to see the method established on a commercial scale. But we want to see it done fairly.

Unfortunately, the history of wireless telegraphy is so knotted and entangled by conflicting expressions of the truth, that the vast majority of the public are in the same position as if the various reports concerning it were misstatements of fact. Under the respectable guise of science, commerce has from time to time achieved much advertisement; this is no doubt legitimate trading. There is a point, however, at which the guise should be dropped. And that point is surely reached when the public, under misconception, based on ambiguous reports, are led to part with valuable stock. Alike in science as in sport, where commerce enters into the question, distinction must be drawn between the professional and the amateur. Both are playing in the same field, but one has his heart in the game and the other his eye on the gate. The public, as interested observers, must look after their own speculations upon the results; but since they sooner or later pay their money, it is only fair that they should be allowed a proper view of the game.

Mr. Marconi, with admirable frankness, warned the public as to the aspect in which they should view what is presented to them. In his lecture reported in the *Journal of the Society of Arts*, May 17th, 1901, he says:—"It is often considered possible that certain new methods and results may, if prematurely published before being fully patented, be utilised by persons whom I might call 'business rivals,' thus preventing those who have borne the initial cost of the first tests from benefiting in a fair measure. I am, therefore, frequently prevented from promptly publishing the methods by which I have obtained interesting results." This, of course, is a perfectly legitimate and wise exercise of discretion. But having that statement of commercial policy before them, the public should put a limit upon credulity, and they should not be enticed to part with careful investments in cable companies by the subtlety of a short succession of simple sibilents sent seawards. So long, however, as they have what we have called a fair view of the game their transactions are no affair of ours.

C

As a first example of the conflicting expressions of the truth told about wireless telegraphy, we may instance the reports that have from time to time appeared regarding the effect upon received signals of atmospheric electric storms. As long ago as 1897, it was pointed out by Mr. Jervis-Smith that the coherer is affected by atmospheric disturbances from storms, even when such storms are at comparatively great distances from the receiving station. In one instance cited by him, the coherer was actuated in this manner at a rate of 25 impulses a minute, by a storm which was computed to be 5 miles off. Again, Mr. R. H. Martin, in the Electrical Review, July 28th, 1899, describes similar interference with a coherer circuit by a storm. He was using a vertical wire, and observed the effect even when this was reduced to 20 ft., and whether an earth connection was used or not. At the Society of Arts (see *Journal of Society of Arts*, May 5th, 1899), Sir William Preece, who, it may be presumed, was fairly well informed on the matter, said: "When Mr. Marconi was showing the working at the South Foreland to the officials at the Post Office, he received a sharp shock. There was atmospheric electricity about, and Mr. Marconi repeated Franklin's experience. Sharp sparks were elicited from this miniature lightning, and at the same time erratic signals were observable at Boulogne." He also gives an instance of like phenomena observed by officers of H.M.S. *Vernon*, at Portsmouth, who obtained, among other disturbances, the letters "A R E."

Now the Atlantic has for many years past been subject to such storms, and there is no obvious reason for believing that there is likely to be cessation of the phenomena. Similarly, the English Channel is from time to time the scene of conflicting elements, and there is no evidence to suggest a break in the continuity of a struggle so constant in inconstancy. When relating some of the experiences of Post Office officials with the Marconi apparatus, Mr. Gavey, at the Institution of Electrical Engineers in March, 1899, asked how the effects of lightning were to be guarded against, as the vertical wire was practically a lightning conductor. The reply of Mr. Marconi dealt rather with the risk of injury to the operator than with the interference with signals. It was to the effect that experience in Italy, where thunderstorms were more violent and more mischievous than in England, appeared to show that no danger was to be anticipated from lightning, and that there was nothing to prevent a lightning conductor being rigged up if anyone desired it, so that the attendant could not be in any danger from atmospheric electricity. The humane were, no doubt, glad of this assurance of safety to the operators, but the commercially-minded had a desire to know how signalling was to be maintained when natural electric impulses were within range of the coherer, and to what extent such disturbances render accuracy in received signals impossible. They were not long left in ignorance. At the third ordinary general meeting of the Wireless Telegraph and Signal Company, Limited, Major Flood Page is reported to have said (*Times*, February 24th, 1900), referring to the installation between the East Goodwin lightship and the South Foreland lighthouse, "the connection was made on December 29th, 1898, and it remained until February 14th, during which time there had not been a single flaw or hitch so far as the Marconi system was concerned. Night and day, in fog, in storm, and in thunderstorm, no difference had been found in the working of the system." There is so grotesque a difference in this report from that of Sir William Preece and Mr. Gavey that we feel we want to congratulate somebody, and we cannot tell whom.

If it is difficult from published opinion to arrive at the truth concerning the effect of local and distant electric storms upon a coherer circuit, it is practically impossible to formulate one as regards the efficiency of working of tuned receivers and the methods of syntony. At the Physical Society, January 21st, 1898, Prof. Lodge explained that with customary forms of Hertz vibrator there was so rapid a decrease in the amplitude of the wave impulse that almost any receiver could to some extent respond. He showed how to construct spark-gap oscillators to produce amplitudes of more persistence, and he explained how corresponding syntonised resonators should be constructed. The syntonic receiver was to contain no spark-gap, but instead thereof a closed wire coil; this self-inductance coil, whose main feature was to prolong the duration of the oscillations, rendered syntony possible, under certain conditions. At the same meeting, Mr. Rutherford concurred with Prof. Lodge on another detail of construction, *i.e.*, the advantage of increasing the capacity of the oscillator. In a paper read by Mr. Marconi at the Society of Arts, May 17th, 1901, these principles are again discussed, and the advantage is shown of connecting the aerial wire of the receiver directly to earth, instead of to the coherer, and of the introduction of a proper form of oscillation transformer in conjunction with a condenser. These efforts of Mr. Marconi to secure syntony, were, he said, "crowned with complete success." The patents relating thereto are No. 12,326, dated June 1st, 1898, and that of Prof. Lodge, No. 29,069 of the same year. There is a further patent of Marconi's, No. 7,777, of April 26th, 1900. As the result of these various improvements, Mr. Marconi stated that "a very great number of non-interfering stations can now be worked in the immediate vicinity of each other." The question is, how are we to interpret this statement?

The inspecting Board, ordered to report upon the subject for the U.S. Navy, give their experience as follows: "When two transmitters are sending at the same time, all the receiving wires within range receive the impulses, and the tapes, although unreadable, show unmistakably that such double sending is taking place. In every case, under a great variety of conditions, the attempted interference was complete." The obvious explanation is that they were not fitted with the syntonised apparatus. But the report continues to say that "Mr. Marconi, although he stated to the Board before these attempts were made, that he could prevent interference, never explained how, nor made any attempt to demonstrate that it could be done." Some excuse is probably to be found in the statement of Mr. Marconi above referred to, as regards premature publication and patent rights; he must not therefore be hastily condemned as having misled the Board. Meanwhile we are anxiously awaiting a demonstration of the results of the efforts that have been "crowned with complete success," and that are to be applicable to the ships of the U.S. Navy. This means that any particular ship must be able to set its tune to that of any other, to the exclusion of all other receivers; it

must carry a receiving gear of its own able to pick up the tune of any ship of the enemy; and its "sent" signals must not affect the receivers of the enemy. The *Times* literary supplement, January 17th, 1902, explains the position when it says that "if ever wireless telegraphy is to become of real commercial importance, means must be found not only to enable two parties to communicate with each other without fear of their message being overheard, but also to prevent a third party from making communication impossible altogether by the simple device of working his own apparatus and thus rendering the signals unintelligible. Even before these requirements comes the necessity of ensuring certain transmission of simple signals over moderate distances. The imperfections of present methods are sufficiently illustrated by the experiences of the *Ophir* and her consorts, and by the difficulty which the Admiralty have found in obtaining coherers that can be trusted to respond satisfactorily over the test distance of 70 miles—a difficulty which has induced them to take the manufacture of these delicate pieces of apparatus virtually into their own hands." Similar experience comes from the army, for Brigadier-General A. W. Greely, Chief Officer of the Army Signal Corps (*Times*, April 15th, 1899), reporting on experiments with wireless telegraphy apparatus, states that "the great delicacy of the system, and constant necessity for the adjustment of the receiver, made the transmission of messages uncertain and unreliable." Theoretically, wireless telegraphy has been "crowned with complete success"; theoretically, syntony is possible even to "a very great number of non-interfering stations"; and, theoretically, all this has our heartfelt sympathy and praise. Practically, we are inclined to agree with Prof. J. A. Fleming, who expressed the opinion (*Times*, April 3rd, 1899) that "wireless telegraphy will not take the place of telegraphy with wires."

Sir William Preece has said that the operations of the Wireless Telegraph Company are "mysterious and inscrutable." He was referring (*Journal Society of Arts*, May 5th, 1899) to their reticence in inaugurating an actual commercial circuit. He says "they were informed that they could connect Sark with Guernsey, and the Post Office would open Sark as a public office." They did not do it; and he calls attention to the fact that "for nearly two years after its practicability was affirmed, not one single independent commercial circuit exists." The curious thing is that last year (*Times*, July 23rd, 1901, House of Commons Report) we find Mr. Henniker Heaton, M.P., who, by the way, is one of the directors of Marconi's Wireless Telegraph Company, Limited, asking the Secretary of the Treasury, as representing the Postmaster-General, "whether anything was being done to connect by telegraph the island of Sark with Guernsey; and whether he proposed to continue the policy of his predecessor in refusing an offer of Marconi's Wireless Telegraph Company to connect Sark with Guernsey by wireless telegraphy without any expense whatever to the Government." The reply was that "the Postmaster-General had no reason to suppose that the Marconi Wireless Telegraph Company were prepared to maintain permanent telegraphic communication between Sark and Guernsey without charge, and it was, of course, permanent communication that was required." If such difficulties and contradictions arise in regard to a short span of the Channel Islands, what are we to expect from an exploit across the Atlantic?

Probably there is some very simple explanation of this discrepancy of ideas; we cite it with the others as an example of the conflicting expressions of the truth in which the subject of wireless telegraphy has become involved. It should be observed that these examples are not the outcome of remarks made by irresponsible newspaper reporters, but they appear to be the result of deliberate statements of those who ought to know. In the circumstances, it is impossible to formulate an opinion as to the real state of progress. All that has come through is a sequence of ess's, and we are left to wonder whether these are coded for "syntony," "stock exchange," "science," or "satire."

Feed Water for Boilers.

IN a paper read by Mr. G. J. Wells before the Manchester Section of the Institution of Electrical Engineers, the author objects to the use of the Porter-Clark softening system as usually employed, and advocates a continuous system. He states also that sulphate of lime is soluble in water as hot as 473° F. to the extent of 12·6 grains per gallon, according to Tilden and Shenstone. This is quite outside general knowledge, and is to be found in *Philosophical Transactions*, Part I., 1884, while if the water is salt as many as 124·6 grains per gallon will remain in solution at 437° F. The paper is one rather of statements of boiler troubles than of means of coping with such troubles. We believe that an excellent way to remove scale is to boil up soda in the boiler two or three times at ordinary atmospheric pressure, letting the boiler cool each time. This seems to have a disintegrating effect on the scale. What has become of the freezing system of which we heard about three years ago? This was supposed to act on damp scale and remove it in a very wholesale manner, and we do not see why it should not do so without injury to a boiler. As regards greasy feed with surface condensers, we think there is a good separator on the market which separates the grease from the exhaust steam before it reaches the condenser. We certainly agree that engineers would be well advised to acquaint themselves with the interior of their boilers more than they do, in order to be able intelligently to comprehend the Boiler Insurance reports. Too often boilers are insured simply in order to shift responsibility from one man's shoulders to another's. Yet the chief of a big steamer is not above going inside his boilers. Manchester hardly seems the place in which to read a paper on this subject. Boilers will run continuously in Manchester with nothing but a little soda to correct the slight peat acidity of the public water supply, and even as far down the river as Warrington, the large works there prefer to pump their water from the sewage-laden Mersey, which has come chiefly by Manchester. Mr. Tritton noted how very remiss engineers were in arranging for water supply, and he complained of the quality of water in the Bridgewater Canal, which has 87 parts per 1,000 of solids (surely a misreport), including 20 of chlorine. We think that probably the proportion stated was 87 per 100,000. One speaker had found 5 tons of salt in a Lancashire boiler. Mr. Wilson grumbled about the green weed or slime in hot wells. Doubtless the warmth promotes the growth of this weed. This speaker, as well as a previous speaker, condemned surface condensers. We fail to see so much objection to the surface condenser. We know it becomes scaled, but why not remove the scale with weak acid, which will not injure the brass tubes, or even try to do so, until the scale has dissolved? Others condemned grease extractors. For our own part, the only grease extractor we have found of any benefit, other than the centrifugal or cream separator type, is one that deals with the exhaust steam on its way to the condenser, and costs nothing to work.

D

METHODS OF ELIMINATING CORRECTIONS FOR THE LEADS, &c., IN CABLE TESTING.

By H. SAVAGE.

(*Concluded from page* 88.)

There is the full potential difference of the battery between the outer and earth, but any leakage there may be is not seen, as it does not pass through the galvanometer. The arrangement is shown diagrammatically in fig. 4. The outer conductor is brought to a key, which is linked by an

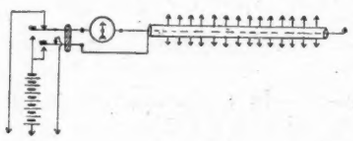


Fig. 4.

insulating bridge to the usual battery key. For simple insulation tests only, the outer may be brought direct to the usual battery key, thus avoiding any special apparatus. In taking capacity tests by discharge or in loss of charge tests (see fig. 5), it is necessary to charge the two conductors

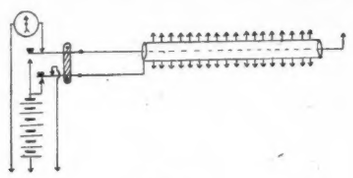


Fig. 5.

together and to insulate them simultaneously, but to discharge the outer direct to earth immediately before discharging the inner through the galvanometer. To do this the guard key should touch the top contact immediately before the line key, and the outer being thus reduced to zero potential when the inner is discharged, there will be no deflection due to the lead.

If a concentric is used in place of the usual two leads to the galvanometer, the trouble due to their capacity will disappear, but care must be taken that the current enters by the outer, that is, the outer conductor must be connected to the double terminal of the universal shunt and the ends arranged on the galvanometer terminals to produce the required direction of deflection.

The concentric lead has, incidentally, two or three other advantages. Anyone with experience of testing is aware of the annoyance and uncertainty produced by the inductive action of neighbouring leads which are being charged or discharged, causing kicks in the galvanometer reading. Although this may be eliminated by enclosing the lead in a conducting envelope which is earthed, the usual methods of lead covering or metal taping are inconvenient and troublesome. The concentric lead affords complete shielding from inductive effects, while as the outer conductor is made up of fine copper wires flexibility is maintained. Another great advantage is, that, as there is no tendency to leakage at the ends, less care is required, and the electrician is less dependent upon his assistant.

A further advantage is that the two conductors may be used for conductor resistance or loop tests without the necessity of running a second lead, while finally the outer forms a ready means of applying the guard to cable ends, as first described.

The concentric lead is also useful for joint testing, although not on the principle described above, but by using it as a condenser to collect the leakage from the joint. The connections are shown in fig. 6. The outer conductor is earthed, and the inner connected to the plate in the trough. The trough is charged with a few cells, and the discharge deflection noted; it is again charged, insulated for a minute, and again discharged; if the loss is small, the insulation of the trough is satisfactory. The cable is now connected by a separate lead to the battery key and charged with, say, 300 cells. This will produce a throw on the galvanometer due to the capacity of the joint, showing that the connections are all right.

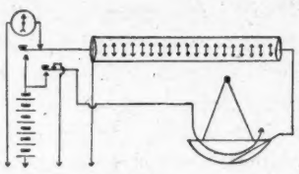


Fig. 6.

Leaving the battery on the cable, the inner conductor is now insulated for a minute, during which time the leakage from the joint is accumulating in the lead. After a minute this is discharged, and the deflection noted and compared with a standard length of good core. It must be noted that as the outer conductor is earthed instead of charged, the inner ends in this test will require to be carefully insulated.

As the usual testing keys are unsuitable for use with the guarded lead in the case of discharge tests, &c., the writer has designed a special key to meet the requirements of the system.* This is shown in plan, together with other apparatus, in fig. 7, and a general view is given in fig. 8.

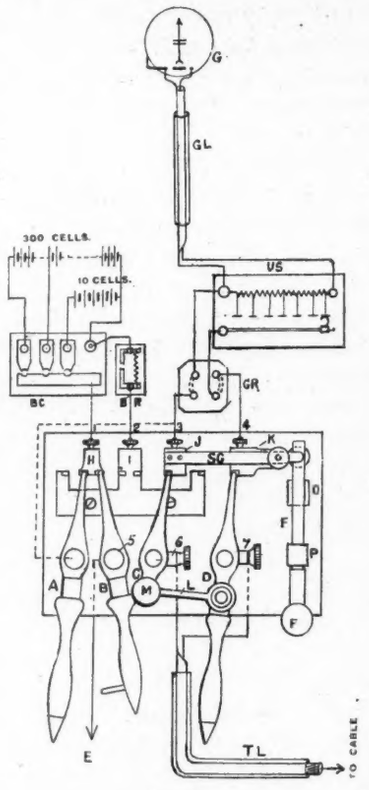


Fig. 7.

The battery is connected by means of a commutator, B C, through a safety resistance, B R, to terminals 1 and 2. The galvanometer, G, is connected through the concentric lead, G L, universal shunt, U S, and reverser, G R, to terminals 3 and 4. A and B are two independent levers, while C is connected by an insulated link, L, to D. H, I, J and K, are brass plates with suitable platinum contacts. The left-hand side is practically a Rymer-Jones key, except that A, instead of being the line terminal, is brought to J. The inner conductor of the lead is brought to 7, the outer to 6, and the earth wire to 5. S C is a brass strip short-circuiting the

* The key is made by Messrs. Gambrell Bros., 17, Giltspur Street, E.C.

galvanometer. This strip can be lifted by an ebonite rod, E,* pivoted at O, and working between stops at P. F is a tapper, which can be slid along the bar under P, keeping the galvanometer open during the tests; in the position shown, it will be seen that the line is earthed. By putting a plug in B C the plate 1 becomes charged; if the handle of A is now moved over to the right, the outer conductor is charged directly through lever C, and the inner through S C. By depressing F, S C is lifted, and the current passes to the inner conductor through the galvanometer. For the capacity test, the lever, D, is moved over to the right, charging both conductors; on switching back, the outer conductor is discharged to earth, and the inner through the galvanometer. The distances between I, J, and K, are arranged so that the outer is discharged immediately before the inner. There is sufficient distance between the contacts to allow the lead to remain

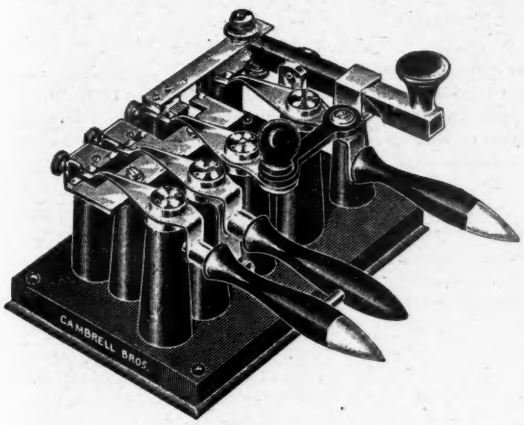


Fig. 8.

insulated for the loss of charge test, and the proximity of the handles permits of the short circuit and discharge keys being manipulated with the fingers of the same hand. It is possible, with a free lead, to move the levers into any position without producing any effect on the galvanometer.

For the joint test, the outer conductor must be removed from terminal 6 and connected to earth. The trough can then be tested for loss of charge, using a battery of, say, 10 cells. Having done this, connect the cable to terminal 6 and remove the link, L; then, by switching over lever C, the joint is charged, and the throw can be observed, proving the connections to be in order. Lever D can now be brought to the middle, or insulating position. The leakage through the joint is now accumulating in the lead, which, after the lapse of a minute, can be discharged through the galvanometer, the deflection obtained being then compared with the usual standard length of good core.

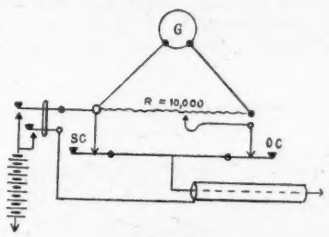


Fig. 9.

The principal disadvantage of the system is, that should the outer insulation break down, there is a risk of short-circuiting the battery for some time before it is found out. It is advisable to test the outer insulation occasionally, and also to keep a safety resistance in the battery circuit as B R in fig. 7, which can be short-circuited when taking the constant.

A galvanometer of low sensitiveness might be inserted in place of B R to indicate any breakdown. If a cable was connected on, having a dead earth fault or its ends not free, this second galvanometer would indicate the fact and prevent the risk of a heavy current being passed through the sensitive galvanometer, G.

A slight kick is sometimes observed when charging a sensitive galvanometer with a fairly high potential, even though it is short-circuited. This is often due to the actual capacity of the instrument, and can be practically eliminated by connecting the frame, case and levelling screws together, and to the end of the coils on the battery side of the circuit, that is, the terminal taking the outer conductor. It would be a decided advantage if the makers would connect all the metal parts of a galvanometer to a separate terminal which could be joined to the charging end of the coils. The levelling screws might be fitted with small ebonite shoes. This arrangement would do away with a lot of elaborate contrivances to secure high insulation.

A common source of trouble and error with galvanometers of the D'Arsonval type is the difficulty of producing constant damping. This is very marked when it is required to check the zero by short-circuiting the galvanometer after taking a reading. If, when $n = 1$, the damping is uniform and the spot returns to zero at a certain rate, then as the value of n, which varies with the position of the slider, is increased, the rate of swing decreases, until when n has a very high value the rate of swing is so slow that it is impossible to check the zero and reproduce the deflection in time for the next minute's reading. Even if this is done the heavy damping on the coil is apt to produce inequalities in the curve of electrification. The connections are usually arranged so that normal damping is obtained when $n = 1$, as is frequently the case when testing short lengths, but when taking the constant through one megohm, n, having a very high value, the short-circuit key is left open and the battery put on. After taking the reading the battery is taken off, and the galvanometer is short-circuited when the spot has returned to zero. This can be done because the standard resistance having no capacity does not produce a rush of current when the battery is put on.

This, however, only partially solves the difficulty. A better plan is to short-circuit the battery and line, breaking the circuit between the cable and galvanometer immediately afterwards. This will have a constant resistance across the terminals and the swing will be uniform. The arrangement is shown in fig. 7. As it is inconvenient to do this with a separate plug or switch, the key referred to above has been modified, so that the circuit is broken by lifting the tapper F. The two operations of short-circuiting and cutting off the galvanometer are thus done by the same lever, without interrupting the flow of current either into or out of the cable. This arrangement has also an advantage when used with an astatic galvanometer, as one leg of the system is cut off, eliminating false zero deflection due to bad short-circuiting, as described by Ayrton and Mather in their original paper.*

THE FIGHT FOR FREEDOM.

Another Parliamentary session has commenced, and in a few weeks the electrical industry will have renewed its struggles in the committee rooms for freedom from the restrictions which embarass its progress, and authority to conduct its business, without legislative interference, upon common sense intelligent principles.

The combatants will represent municipal monopolists under socialist leaders on the one hand, and private British enterprise on the other.

"The Fight for Freedom" will be arduous and costly, but must triumph in the end. The town clerks and councillors will flock to London, and fill the committee rooms with an army of expensive expert witnesses, Parliamentary agents, barristers, and others, who will expend thousands of pounds of the ratepayers' money in the effort to prevent private trade from running a free course.

At no time in the history of the British nation was the encouragement of our trade and commerce more essential than at this moment; enormous sacrifices have been, and are being, made in prosecuting the war in which the country

* Incorrectly shown as F in figure.—Eds

* See Electrical Review, April 6th, 1894.

is involved; commercial transactions are conducted with more difficulty in consequence; the money market is disturbed, and to meet the severity of the strain upon the national resources, our traders must be freed from every possible restriction upon their enterprise.

Is this a time when public money should be employed in restriction of trade, and in preventing the removal of abuses that have especially hampered the electrical industry?

Judging from the preliminary notices that have been published, Parliament will be asked, on behalf of those representing private enterprise, to amend existing enactments relating to the promotion of tramways, light railways, and electricity supply, while municipalists will seek further powers for trading in competition with them.

The success of the local authorities depends, to a large extent, upon the apathy and ignorance of the ratepayers, and it is, therefore, a healthy sign of the times to find that in some localities public opinion is being aroused, and the schemes of the municipal traders defeated.

Notable examples of this awakening interest have occurred at Birmingham and South Shields, where the ratepayers have refused to sanction the municipal trading promotions, and the meeting last week at Finchley, under the Borough Funds Act, which rejected the proposal of the Urban District Council by an overwhelming majority, affords additional evidence of the objection to such speculations.

In order to enlighten public opinion and counteract the action of the Incorporated Municipal Electrical Association, an important movement is in progress for organising a great national combination of the trades connected with the electric industry. We advocated such an undertaking in our issue of the 6th ult., and are glad to know that the matter is being developed.

Local authorities have embarked upon municipal trading, through adopting principles theoretically unsound and practically opposed to the best interests of the community.

They seek to defend their illegitimate interference with private enterprise, mainly by assuring the ratepayers that the rates will be reduced as the result of the trading, and there are probably some short-sighted and selfish people who are willing to ruin their neighbours who carry on a trade in which they are not personally engaged, if they can reduce by such means their own contribution to the rates.

But, if the principle of municipal trading be admitted, where will it end? There cannot be any limit short of honest John Burns's declaration that all trade must be in the hands of a labour-governed State.

The favourite cries of the municipal trader are "Reduction of rates," "no monopolies," and "supply of the public on better terms than the private trader." Even if these results were obtainable, they are altogether foreign to the duties of the local governing bodies who have quite enough to do without embarking upon business they know nothing about.

But, so far as electricity supply is concerned, the stern logic of results has falsified all their claims. Rates have *not* been reduced, the worst kind of monopolies have been created, and the public have not been supplied upon better terms than by the private trader.

As the public become better acquainted with the actual results of municipal electric works, they will find that scarcely any show a legitimate profit when the accounts are subjected to examination, and there is evidently a growing desire on the part of ratepayers to see their towns relieved from responsibilities that ought never to have been incurred.

An instance of this occurred the other day at Bath, when the disastrous results of the municipal trading culminated in an entire breakdown, and caused Mr. Dickinson, M.P., who is a member of the Council, to suggest as *the best conclusion they could arrive at, to make up their minds to end their connection with the electric light.*

May we hope that the labours of the Parliamentary Committees about to meet, will promote a wholesome change in the policy which has so adversely affected the electric industry in the past.

The legislation affecting tramways and light railways, requires reforming on the lines pointed out in a letter addressed to the Board of Trade by the Tramways and Light Railways Association on December 22nd, 1900, viz.:—

1. That the Tramways Act should be repealed.
2. That the provisions of the Light Railways Act should be extended.
3. That the commission appointed under the Light Railways Act should be made permanent, and the procedure as to the authorisation and construction of tramways should be brought within the provisions of the Light Railways Act.

The old Tramways Act—passed before electric traction was thought of—is obsolete, and should be removed from the statute book. The Light Railways Act passed in 1896, practically disposed of the most objectionable features of the 1870 Act, by limiting the interference of local authorities, giving no special powers to frontagers, and improving the purchase clauses by extending the time to 35 years, and then selling at a fair valuation, but this Act does not remedy the defects (while by inference it condemns them) of the old Act, as its provisions do not affect the same areas. This absurd anomaly will, of course, be removed when Parliament can find time, by simply repealing the Act of 1870, and thus promote increased facilities for the modern system of traction.

The pressing nature of the problem is admirably illustrated by the position in the North Metropolitan district. The London and North-Western Railway control the North London line from Willesden to Broad Street. Between Willesden and Hampstead Heath, with stations at Finchley Road, West End Lane, Brondesbury, and Kensal Rise the line is on a high-lying and healthy land, well adapted for dealing with the housing question. There are over 4,000 acres suitable for building, and it is not available, because the railway company do not provide a train service. The company will not provide trains till the population is there, and the population cannot go until the trains are provided. It has been forcibly pointed out that from Hampstead Heath there are no trains to Broad Street before 10 minutes to 8 in the morning.

The Midland Railway is equally neglectful in assisting the great housing question. From West End station the line to Hendon lies through country capable of providing building land in large quantities, but the character of the train service may be judged by the fact that the last direct trains from Moorgate to stations on the Hendon line are at 5.37 and 6.39 p.m.

The Electric Lighting Acts also await amendment for removing the power of obstruction on the part of the local authorities by limiting them to petition to, and giving evidence at any inquiry by, the Board of Trade before a provisional order is granted.

In the present condition of Parliament there is not much hope of useful legislation by public Acts in furtherance of the interests of the electric industry; but it is to be hoped that in the conduct of the Private Bills the Committees will afford assistance to the promoters of the Acts for extending the powers of enterprising companies, and will discourage the efforts of the Socialist party in their endeavours to thwart private trading and extend municipal speculations, which have already involved such heavy losses to the ratepayers.

GUARD WIRES AGAIN.

What a vexed question this is; a question which will remain vexed, and a prolific source of vexation, till the guard wire itself is no more.

What with editorial articles and gratuitous correspondence, what with reprints of learned papers, and learned criticisms of those papers, the Electrical Review has dealt with the guard wire from every point of view; yet not too fully, not to the point of redundance, if the vital importance of the subject, its lively interest to the chief parties concerned, be considered.

With our known loyalty to Government we touch our hats, and name H.M. Post Office as the premier party concerned, endeavouring to make it clear at the same time that not a fraction of the kow-tow is addressed to the National Telephone Company, which is seen, to the surprise of all, linking arms with, and breathing soft conspiracies into the

ear of the august Department; while, greater wonder still, opposing these born antagonists, stands a solid homogeneous mass, which, when analysed out, is seen to consist of two kinds of atoms as heterogeneous as it is possible to conceive—to wit, the tramways owned by public bodies and by public companies.

Unfortunately, as regards the second pair, the wish is father to the thought, as the battalions are only in skeleton form. However, the nucleus is there, and the recruiting sergeants are bestirring themselves to rally every fighter to the standard. The colours have not appealed in vain to the Electrical Review, which has once more pipe-clayed its belt and is marching to the front, calling on all in the way to fall in and follow the band.

The actual fiery cross reached us by the hands of the secretary of the Tramways and Light Railways Association, who drew our attention to the proposed new regulations on the subject of guard wires lately issued by the Board of Trade. These, if sealed, will increase to a considerable extent the burdens which the same department has already piled on electric traction undertakers at the instance of owners of message wires.

Early last year the Electrical Trade Section of the London Chamber of Commerce interviewed the P.M.G. with regard to the regulations which the Board of Trade are now proposing to adopt. Put briefly, the P.M.G. demands—was demanding last year even—that wherever trolley wires and message wires are parallel, the latter being within 30 ft. and above the trolley wires, not only shall hooks be attached to the span wires or bracket arms, but guard wiring shall be erected as if the message wires were actually crossing; and, where the two sets of wires are very close, such guard wires shall be laced.

Now, so far as we understand the case, the position taken by the tramway undertakers is that the P.M.G. has absolutely no right to dictate his "requirements," as the clauses for his protection inserted in the Acts and Orders refer merely to the injurious affection of the message lines by induction or leakage from the tramway wires, and not at all to protection from damage which can occur only if the message wires themselves fail, in which case the tramway undertakers maintain most strongly that any damage resulting is due to the faulty construction, or inefficient maintenance of the message wires, against which they cannot be reasonably required to guard. The Association in their reply to the B. of T., view the whole question in a way which should appeal to every fair-minded man. They raise no objection to the usual guard wiring arrangements, but they have drafted amended readings for the other proposed regulations.

It is proposed that, when crossing wires are erected *after* the trolley wires, the cost of the guard wires shall be borne by the owners of the crossing wires. At the present time there is much uncertainty as to payment for work done under these conditions: although it seems only equitable that the late-comer, who is also someone who feels that his wires are likely to fall, should be mulcted, and we shall be glad to see litigation saved by the insertion of this clause.

The Association propose that, where guard wiring would be difficult, on account of the great weight of crossing wires, or for other reasons, and where such guard-wiring might prejudice the proper and safe working of the tramways, cables carried either overhead or underground shall be substituted for the crossing wires, the reasonable cost of conversion being borne by the tramways. No objection is raised to the use of hooks, placed on span wires, and on the tie rods of bracket arms, to catch falling parallel wires; but guard wires, and the lacing of guard wires as a means to prevent contact between the trolley wires and a falling parallel wires, are classed as impracticable; and we think that every tramway man in the country will endorse this statement. In order to deal with these parallel wires, the Association suggest that a single well-earthed wire should be stretched either between the tramway poles or between the message wire poles themselves.

The fact is, that parallel wires cannot be absolutely prevented from touching the trolley wires if they are broken in a strong wind, but it is quite possible, by the very simple means suggested, to ensure a good earth connection before contact, thus avoiding any danger to lieges or instruments.

The G.P.O., and the N.T. Company say that, as their wires never did any harm before the overhead trolley appeared, therefore they should be allowed still to let them rot on the poles, and fall around for ever, regardless of the progress of the rest of the world.

The tramway undertakers hold that, on the comparatively few occasions when their wires fall with damage, they are quite willing to pay the piper, but they do not relish the idea of paying as well for a tune someone else has called.

Much lasting good will result if the efforts of the Association are crowned with success, but they will have a tough and uncertain fight unless they are backed by all the tramway interests in the country.

The existing guard wires prevent one wire from contact, while nine accidents of various kinds are happening on account of the guard wires themselves. To what proportions would these accidents be raised if the P.M.G. and his mimical conspirator obtain the sealed acquiescence of the B. of T. to their burdensome requirements?

POLYPHASE WORKING.

The vitality of any branch of pure or applied science may not unreasonably be inferred from the amount of discussion which arises in connection with it. Judged by this standard, the outlook in electrical engineering is certainly a hopeful one; few subjects have excited such animated discussions in technical circles as those which engage the attention of electrical engineers.

Apart from what may be regarded as single combats or insignificant skirmishes—isolated discussions of mere questions of detail—there have arisen, from time to time, problems which have given rise to battles royal, and have caused the entire body of electrical engineers to split up into opposing camps. At one time it was the battle of continuous *versus* alternating currents; now it is the battle of the phases.

Slowly, but surely, the interest taken by electrical engineers in this country in polyphase working is increasing. Polyphase currents have come among us, and can no longer be ignored. A careful study of the complicated problems presented by them becomes imperative, and any effort to elucidate such problems is to be heartily welcomed.

Mr. Eborall is to be congratulated on his successful efforts in this direction. We are already indebted to him for the excellent paper on "Polyphase Sub-station Machinery," read before the Institution of Electrical Engineers last year; and this debt will be further increased by his Howard lectures.

To compress a fairly complete account of all the main features of polyphase working into the space of four lectures is no easy task, and we cannot help admiring the way in which Mr. Eborall has succeeded in accomplishing it. The Howard Lectures are by far the best and most readable account of polyphase working which we have, as yet, come across. The lectures, we are glad to hear, are to be published in book form, and will, no doubt, undergo a process of expansion and correction.

The standardisation of large polyphase generators furnishes an excellent example of the danger of making rash predictions. It is not so very long since we were assured by some writers that the inductor type of generator was *the* machine of the future; no moving coils, thoroughly sound mechanical construction, and what else could be desired by the most exacting of critics? To-day all this is changed: large fly-wheel generators are supplanting their rivals of the inductor type; experience having shown that, from an electrical and magnetic point of view, generators of the inductor type possess certain undesirable features.

There are one or two points connected with Mr. Eborall's treatment of the subject of polyphase generators to which we wish specially to refer. In dealing with the advantages of a distributed winding, he says:—"Moreover, a sinusoidal E.M.F. wave results." This inoffensive-looking little sentence suddenly brings back to our memory the din and noise

of another long-fought battle—that of the pure-sine *versus* the distorted wave-shape. What intrinsic value is there in a pure-sine wave? When we are dealing with very long transmission lines, or with underground cables, or, in general, with problems involving the consideration of capacity, the absence of harmonics in the wave may become an important consideration. But from many other points of view, a distorted wave of special shape, to be used for a special class of work, is undoubtedly preferable, or, at any rate, not inferior to, a pure-sine wave. In considering the ampere-turns of a three-phase armature, Mr. Eborall deduces the constant multiplier which converts the product of armature-turns and R.M.S. value of current into armature ampere-turns, by taking the case of a two-pole machine. He then states that the constant derived is, in practice, found to be too small, and explains this by saying that the armature current does not obey the sine law strictly. The fact is, that this constant in any actual machine (even in one with a perfectly pure-sine wave) is greater than that obtained by him, for the simple reason that in practice no two-pole machines are ever used. The value of the constant increases with the number of poles, and the reasoning employed by Mr. Eborall holds only for the special case of an ideal two-pole machine.

The treatment of polyphase transformers is thoroughly satisfactory, their advantages over those of the single-phase type, the advantages and disadvantages of star and mesh connections of their windings, and the important part which they play as regulators in a polyphase system being very clearly and fully explained.

The lecture dealing with polyphase induction motors will, we hope, undergo some correction and considerable expansion before appearing in book form. We notice the time-honoured statement that the iron losses in the rotors of induction motors are insignificant. There seems to be little direct experimental evidence in support of this view. Such measurements as have been carried out seem all to point the other way, viz., that *the iron loss when the rotor is at rest differs but little from the iron loss when the rotor is running under normal load.* This experimental result probably accounts for another well-known fact, viz., that in the case of induction motors, the actual iron loss is always found to be considerably in excess of the calculated one (on the supposition of negligible iron loss in the rotor). The elegant diagram due to Heyland is very clearly explained. It seems a pity that no reference is made to an extension of the diagram to the case of an induction motor running above the speed of synchronism, and acting as an induction generator. Such induction generators possess many interesting features, and their behaviour has been studied in detail by Leblanc, who advocates their use under certain conditions.

When the Howard Lectures, revised and expanded, appear in book form, we shall have an important addition to the meagre literature of polyphase currents in the English language.

CORRESPONDENCE.

The Testing and Management of Electric Motors.

I am sure a great many of your readers, besides Mr. Cramp, must have been surprised to read, in your issue of January 3rd, in Mr. P. T. White's article on "Testing and Management of Electric Motors," that a good plan to test for the field connection is to experiment with the starting switch, with the armature leads disconnected, so that when you get a flash by breaking the field circuit, you know that the connections are right; but he forgets to add that by so doing you have probably broken down the field. That's a mere detail, but it's very amusing reading, since, just before coming to the instructions, Mr. White talks about injustice to manufacturing engineers.

Although Mr. Cramp points out that this method of testing for field connections is bad practice, he does not suggest another. A method that I employ is the following: Always put the starter in on one side of the system, say the negative, testing for this in the ordinary way, either by using a piece of test paper or a glass of water; the shunt is connected to the starter, so that all one has to do is to connect the shunt wire of the starter to the positive side of the field on the motor. Putting the starter always on one side of the system has other good points besides this, especially in a large works where a number of motors are running.

Mr. White says in hint No. 6 "That the starter is not by any means intended for a shunt breaker." I would like to point out that any starter that admits of the shunt circuit being broken ought to be scrapped. Hint No. 7 is rubbish, unless intended for series motors, and even then the efficiency does not begin to fall off until somewhere about three-quarter load is reached.

I am pleased to see this matter taken up by a technical college man, because it is so often supposed that nothing practical is taught at those places. If Mr. White had attended the Central Technical College he would have known better than to write such stuff to a leading electrical paper.

Frank Powell.

Doncaster.

I notice that there is another Richmond in the field—Mr. Wm. Cramp, of the Central Technical College—and I am therefore under the necessity of further trespassing upon your columns for a reply, which I shall make as brief as I consistently can.

It is strange, passing strange indeed, that no sooner has a man taken up the pith balls and glass rod of science than he becomes obsessed by the idea that science is as a closed book to all except himself. In his letter Mr. Cramp makes two assertions, and he himself assumes a very controversial and dictatorial tone, yet he does not advance one tittle of proof in support of his contentions. When anyone takes up his pen to write for, or to, a technical journal, he must be prepared to show that he has at least an elementary knowledge of the subjects upon which he writes, and that he can leave the idiosyncrasies of his rostrum on one side for the moment. The bald assertion that I said so-and-so or did such-and-such will not do. There is by far too much of the "there is no appeal beyond C——" about the tone of this letter to please those who do not go to the C.T.C. for their science, and who cannot accept that body as an irrefutable authority.

I must refer Mr. Cramp to his text-books. In them he will find certain formulæ which have a direct bearing on one of his subjects. Using the ordinary forms here are a few:—

$$\frac{w}{W} = \frac{E\,(e - E)}{e\,(e - E)},$$

or, finally,

$$\frac{w}{W} = \frac{E}{e}.$$

This is the mathematical law of efficiency, and it is known as the *law of Siemens*. By it we see that the efficiency of a motor is as near unity as possible when the values of E and e approach each other as near as possible. Now w equals the power utilised, which in its turn equals the difference between the total power supplied and the lost watts, or

$$w = e\,c - C^2\,R.$$

By the help of the *calculus*, or even without it, it is possible to find when *the greatest value that w can possibly have, will occur under all and every condition of load.*

I have stated in hint No. 6, p. 9, "That the starter is *not* by any means intended to be a shunt breaker," and Mr. Cramp takes exception. Had he waited for the conclusion of the articles he would have saved himself much tribulation. Let Mr. Cramp and his students trace out the connections of a motor circuit, or take the diagram given on p. 9, and keep in view the following facts:—The exigencies of everyday work forbid in many cases, and especially in the case of large motors, the removal of the motor armature in order that the commutator may be trued up; that for this process the machine is driven—usually by a small motor; that motor commutators are encased, and of necessity somewhat inaccessible; that large machines are multipolar, and consequently the removal of the brushes

from one spindle is, from the point of view of economy and time, deemed sufficient; that faults causing the flats and irregularities which the process of truing up is intended to remedy, may be present, and that the tools used for the purpose may be, and as a matter of fact are, rested upon some part of the motor case—then ask themselves why it is that the starter is *not* by any means intended to be a shunt breaker, when the reason why it is *not* will stand before them plain and palpable. The cut-outs will have been removed from the source of supply, and the starter is at the "off" position. The "shunt" of the motor is *apparently* broken at the starter, so there is no apparent reason *in the circumstances* why the motor should act as a generator when driven. Now let the armature main be traced from the motor terminals, and the *real*, as distinguished from the *apparent*, condition of affairs becomes evidenced. The "shunt" is not broken at the starter; it is continued through it from A to S, and thus completes the circuit. When some blinded operator, neglectful of the hint given, finds his way into the outer world from the seclusion of the hospital, his best course will be to offer himself to some technical school as a living proof "that the starter is *not* intended to be a shunt breaker." *Let it be as a lesson unto the musicians.*

In the wording of paragraph 5 in his letter, Mr. Cramp is decidedly unfortunate. I do not forget that "there will be a large electromotive force of self-induction induced in the windings of the field itself," but I *do* fail to see what a laminated field has to do with the position he advances. *Whether the magnets are laminated or not*, the armature will lie in a magnetic field. Whether the brushes are raised or not will not, in the circumstances, affect matters, even though the armature in itself were not a *closed winding*. Neither has Mr. Cramp, nor anyone else, nor have I myself, ever yet known of a magnetic field with *a closed winding*.

Unhappily, Mr. Cramp is so sparing of his data that I am not in a position to gauge his exact knowledge of the subject, though I must assume, from the position he holds, that he is an able man. What is it that Mr. Cramp fears? Where are the necessary particulars as to the design and condition of the motor or motors that Mr. Cramp asserts he has known damaged by the method? Does he fear the breaking of a circuit of high induction? Are there not in everyday use coils of higher induction than those of any motor, the circuits through which are made and broken with appalling rapidity and impunity? What is the greatest E.M.F. of these coils, and what special precautions are necessary? Does Mr. Cramp forget that an armature forms in itself a closed circuit of high induction and low resistance? What bearing will this latter fact have upon his contention? Has he opened the armature circuit, and then closed same by the introduction of suitable apparatus, and tested the matter practically, and if so, what was the result?

The design of the schools is different to that of the workshop. The latter follows certain lines which are determined by certain technical laws, and also by laws of a wholly empirical nature. *These* laws are founded on experience, and experience alone. The design of the dynamo and motor of commerce is conducted under certain limitations which do not obtain in the schools. At another, and more fitting, opportunity I will enlarge upon this matter.

It is when Mr. Cramp comments, without authority, upon the mis-statements and wrong methods advanced and advocated in the technical press, that the writer's gorge rises within him. Does Mr. Cramp forget that the technical press exists for the instruction and information of engineers, and others who are not engineers? Before he reduces to the rank and value of waste paper many valuable articles and classical papers and reviews—which cannot be controverted by anything ever likely to emanate from the Central Technical College—let him pause and consider. The interval so occupied will be fruitful of wisdom. It is only the half knowledge of a subject, unboosted by practical experience, which sends into the world so many hopeless ineptitudes. Personally, I have the greatest respect for the writers of the technical press, and I can, with every confidence, commend their writings to those students who doubt the infallibility of their lecturers. In the present year's issue of this paper there is an article on sparkless commutation with fixed lead, which will do much to assist them towards an exact knowledge.

P. T. White.

Wigan Electricity Works,
January 18th, 1902.

Distribution Cables for Three-Phase Working.

Referring to the article upon "Distribution Cables for Three-Phase Working" which appeared in your issue of 10th inst., I observe it states that there is no necessity to cut the conductors when making a connection to a consumer.

This is, of course, an undoubted advantage, but the manner in which it may be effected is not quite so obvious. With lead-sheathed cables of the design shown, whether laid on the solid system or drawn into conduits, there appears, at first sight, to be considerable difficulty in separating or spreading the cores sufficiently to admit of the soldered joint being made, and there would be considerably more difficulty in properly insulating the joint afterwards, owing to the practical impossibility of getting any "slack" cable when the cores are twisted inside the lead sheath.

As this class of cable is likely to be extensively used in the future, I suggest that it would be of general interest if the cable makers would complete the description by giving details of the method of jointing for consumers' connections, both for three-core power supplies and one core to neutral for lighting supply.

M. R.

January 20th, 1902.

With reference to an article by Mr. S. Woodfield in the ELECTRICAL REVIEW for January 3rd, he states that:—"Concentric cables are out of the question for satisfactory results for three-phase working," but in districts in which a lighting load only is probable, could not the inners of the existing cables be equally divided between the ends of the star windings and the outers connected to the neutral point?

In an article on "Distribution Cables for Three-Phase Working" in the ELECTRICAL REVIEW for January 10th, a statement is made that, for concentric cables, "the serious objection to having to cut conductors at every consumer's box cannot be overlooked; indeed, three-core cable is, on account of this objection, rapidly coming into use for continuous current;" but I should like to know of the three-core cable it is unnecessary to cut when laid taut in the ground. I have found it necessary to cut three-core cables in order to separate the cores sufficiently to get fittings on.

Can you inform me if there is a book published dealing with the practical testing for faults on heavy electricity mains (not for submarine cables), and one describing methods in which tramway return currents are not liable to make accurate testing impossible?

I should also be obliged if you could arrange for an article to be given by one of your contributors on the testing for faults by the telephone method, with sketches, diagrams, &c.

If you know of a method by which a fault on, say, $\frac{1}{2}$ mile of 1 sq. in. cable can be located, several readers and myself would be obliged for the information.

Query.

[Messrs. Stuart A. Russell and F. C. Raphael have written books on practical testing.—EDS. ELEC. REV.]

A Merry Christmas.

A wet day, and thawing fast after severe frost. Outside assistant preparing to spend the day at a friend's house, and pitying the poor beggar, Brown, on shift at the works.

Knock at the door, and note handed in by landlady (who states bearer is waiting), which reads as follows:—

"Dear ——,—Merry Christmas, old chap! Dead short on No. 6 H.T. feeder; have telephoned the chief.—BROWN. P.S.—You can use the bearer to get jointers and labourers out." The bearer, a greaser, is forthwith sent for men, with instructions for them to bring tents, tools, &c., to faulty district, which, as bad luck will have it, is the best residential one in the town, where the mayor and all the big bugs live.

10.30 a.m.—Faulty section localised between two disconnecting boxes about half-a-mile apart by the primitive method of disconnecting section after section, and running an alternator up on the faulty feeder after disconnecting each section: the faulty one is found when the fuse does not go. Jointers sent to consumers on this section to examine and switch out house transformers; they return about 12.30 with news that they are unable to get into several houses, the occupiers evidently spending the day with friends.

1.0 p.m.—Raining faster, and fog coming over. Brown informs the mains assistant by telephone that the mayor, chairman, and Major Slashem have rung up, and want the light—they cannot see to eat their lunch; and as he is unable to localise a fault with transformers on main by testing, the only alternative of cut and try at service boxes is adopted.

3.0 p.m.—The shades of night are falling fast; fault localised within 200 yards, when a passer-by gives the information that the gas men have been working higher up, and he thinks one of them struck the electric wire with a pick. He is given the price of a drink to point out the place, and when main is bared, a hole larger than a sixpenny bit and signs of charring set all doubts at rest.

It is evident that a pick has pierced both armour and lead to outer, and the sudden thaw has sodden the paper and caused the main to break down.

The foreman jointer makes a record joint, and juice is on and all O.K. by 5.30 p.m., not before there are signs that consumers are beginning to be resigned to their fate, and making the best of things by decorating the rooms with candles stuck in beer bottles.

The assistant and jointers homeward plod their weary way, with empty stomachs and prospects of cold fare, wish each other a merry Christmas, and may the devil toast those gasmen!

Station Engineer.

The Tramway Junction at Sheffield.

When your columns are used to disseminate ideas or express opinions upon technical matters affecting your readers, generally such a channel is invaluable, but I for one decline to make you the agency for the exchange of sarcastic letters beneficial to no one.

I had decided not to further trouble you upon the above. The real arguments, however, as advanced in my letter, have either been misunderstood or purposely ignored by your correspondents. I appear to have stirred up a feeling entirely foreign to my own thoughts. The similarity of your four correspondents' letters *may* be a coincidence, but it is suspicious.

All your correspondents appear to have a very intimate acquaintance with this junction, yet they display an astounding ignorance of the details of its construction. My statement that the work was unique in its character, is sarcastically ridiculed by "B. B.," and "Permanent Way Engineer." I believe I have seen every English-working tramway, and I challenge "B. B." to locate me a similar junction with *all* parts (rails, points, &c.) constructed *entirely* of either manganese or crucible cast-steel, possessing the same variable gradients, and entirely devoid of fishplates or tie rods, and having the same quantity of metal over a similar limited surface area. "B. B." infers there are several. "P. W. E." states he has, during 11 years of electric traction work, built "many, and far superior." Where are they? I repeat my statement, the work is unique, every part being built of manganese steel without tie rods or fishplates, and seeing that nearly 2,000 cars take the junction every day, carrying nearly 100,000 passengers, the Sheffield Corporation took a bold step in adopting it.

I am accused of holding a manufacturer's brief; jealousy and inexperience are arguments used against my letter. The first two I dismiss with the feeling they deserve; to the latter I can only say that for 17 years I have, I think, been engaged upon as many different systems, and as much line mileage as most men. I have not had "11 years electric traction experience," like "P. W. E.," although I have a recollection of seeing the first English electric tramway opened in 1895 at Bristol, and a few weeks later I saw Coventry opened. His experience seems to be a little prehistoric.

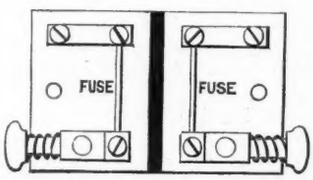
What is the object of this discussion? My letter simply voiced the opinion of many professional men I have talked with. I have not used manganese steel, or had any direct experience with it, although I am watching its working in various parts of the country. Little as I know of the work, I consider that the present junction is far superior for the work it has to do than the old points and crossings. Questions of defective super-elevation, gauge, &c., are copy-book phrases one is used to. If the work is successful, and stands the severe strain I am told it is now put to, it marks, I argue, the most distinct advance in tramway work we have had. Personally, I welcome it, simply because I have hopes it will successfully compete against American methods of manufacture, methods that alone enabled America to obtain the recent L.C.C. contract (*vide* "Engineer's" report). I am pro-British enough to feel that public authorities are making a very serious error in having foreign-built lines, an error that will be seen when small renewals are required, especially by a small system. It is rarely we hear of America obtaining permanent-way work from England. English engineers are a little too prone in visiting foreign lines and copying same; if, therefore, your correspondents *are* engineers to any tramway system, I am surprised (with the monopoly of experience they have) they have not welcomed an improvement upon our present methods.

Electric.

Connector for Testing Purposes.

I notice in your issue of November 29th last a useful connector made by the Silvertown Company. I enclose a sketch of the same thing applied to a pair of testing terminals, which I have had in use about 7 years.

I find the contrivance extremely handy for testing with currents up to about 10 amperes.



The square plunger is kept out a certain distance by a spring, and on pressing the ebonite knob, the two holes come into line.

By inserting the wire and releasing the knob, the spring causes a fair grip of the wire. The edges of the holes being well rounded, quite small wires can be clamped without being cut. A pair of fuses protect the terminals.

James Sugden, A.M.I.E.E.

Twickenham,
January 20th, 1902.

Poor-Gas Producers.

I was interested in reading the description of the Taylor poor-gas producer in your last issue, and as there are now on the market several producers for similar purposes, I think a comparative test of these would be very useful to anyone who, like myself, is at present considering the question of producer gas. Some few weeks ago you described the Walker system, and there are also now, in addition, Messrs. Crossley Bros. and Messrs. Schill Seebohm's patents, the latter being made by the Hyde Engineering Company, near Manchester.

I do not know whether you have seen the system, as described, at work at Messrs. Horn's premises in London; I have, and the thing that strikes one most is the small space occupied by the producer for the power generated, in comparison with other types where gas-holders are used.

You make a strong point of the advantage of the gas produced by this generator being *below* atmospheric pressure, but is this really a good point in practical working, if there

happen to be any slight leaks in valves or pipes. Would not this, without even stopping the engine entirely, bring down its efficiency considerably?

I should imagine that the fact of the engine having to *draw* its gas from the producer would also mean that power would be absorbed for this purpose, and this, together with the fact that the gas is of very poor quality, would necessitate an engine of much larger size to get the same power, than one driven by town's gas or other producer gas of better quality. What percentage greater would this have to be?

The engine described by you as being run from this plant is only of small size, and one would like to know something about, say, engines up to 60 or 100 B.H.P.

Such a test as suggested, carried out by an independent expert, would help others who, like myself, are seeking information. I am open now to purchase the best and most efficient gas generator on the market.

Enquirer.

[For reply see our "Notes" columns.—EDS. ELEC. REV.]

Electric Feed Pumps.

I am sorry that I offended such an eminent firm as Messrs. Mather & Platt by neglecting to mention their speciality in electric *feed* pumps. I have, myself, designed a feed pump which is regulated by a method equivalent to altering the length of the stroke, but it would not hurt my feelings in the least if Messrs. Mather & Platt or anyone else told me that they had never heard of it.

I was aware that a direct-coupled electrical pumping set had been installed at Bristol by Messrs. Merryweather and Sons, but should like to hear of others. The pumps referred to are neat and compact; the cylinders being arranged, like those in Brotherhood's engine, 120° apart, allow the three rams to be driven by one crank. Information regarding the working performance of this set would be interesting.

A. Johnston.

January 21*st*, 1902.

Large Engines for Traction Work.

In reference to your article on "Large Engines for Traction Work," it is quite true that in no other country in the world can we find high speed engines of the quality to be found in Great Britain. The proof of the high speed being wanting in other countries is, that it is only quite recently that the big foreign dynamo makers have got out a line of machines for these special engine speeds, and some of them with great misgiving as to their success on this account. As regards the enormous strength of parts being required in engines for traction work, this is certainly one American theory which will not bear investigation.

As my company have many engines which have been running for a considerable time with complete success on 50 per cent. overloads for as much as 15 minutes at once, and 100 per cent. momentarily, but none of these have the extra heavy parts as required by American practice, I fancy the reason for their success lies in the fact that they are lubricated efficiently, and that they have the large crankpins and crosshead pins of English practice, the crankpins being the usual weak part of an American engine. I have seen the Glasgow engines three times, and quite agree with you in all your remarks, but still these are representative of the best American practice. The last time there I counted seven greasers and two engineers to attend to one of these sets, and it was not a trial run, as the engine had been running in service for a considerable time. But why all this complication of gear, &c., which causes the Corporation to pay so much money in wages when the same end can be attained in another way? Why Corliss gear and its 36 joints (in an average gear) and four stuffing boxes, each joint being dependent on a grease cup and a man to fill it, and consequently a filthy gritty engine? Your readers, no doubt, will say, But what about the steam consumption? Well, this can be obtained by simpler means and with valves much more suitable for superheated steam. Are their engines more economical than a marine engine? I think not. For land purposes the link motion would be omitted, and you will have, for one cylinder, one gland, one valve guide, one eccentric rod joint, and one eccentric in place of the multitude of joints in a Corliss or grid valve gear. If you adopt the high-speed engine builders' ideas, and enclose everything and fit forced lubrication, we have an engine that will beat the Corliss or grid-valve engine hollow for maintenance and reliability, the one being a straightforward job, and the other, with its grid valves in cylinder covers, &c., badly drained, unget-at-able (if I may use the word), and not reliable, or Corliss valves, which nine people out of ten think are perfectly balanced. I grant they are almost balanced when open, but not until then. If working with steam of 150 lbs. pressure, and 250° superheat, it is this want of balance, and difficulty of lubrication, which causes the Corliss valve to commence cutting. The exhaust Corliss valve is as bad as the steam valve, as it is more unbalanced than the former.

As regards economy, my firm tendered for some large 6,000 H.P. sets recently, and guaranteed, under heavy penalty, 10½ lbs. of steam per I.H.P.; also they guaranteed that one engineer and two greasers should be able to run the two sets, the saving in this latter item alone being equal to £15,000 capitalised at 5 per cent., as compared with the American engines at Glasgow.

Wm. Stead.

Patricroft, *January* 20*th*, 1902.

Copper Conductors.

I should be glad to know upon what basis the I.E.E. Committee on Copper Conductors fixed the carrying capacity of wires and cables, as given by them. I presume the formula is a combination of area and surface. Perhaps some of your readers would enlighten me.

Enquirer.

SOLDERING FLUIDS.—A correspondent asks us whether the use of patent soldering fluids in jointing cables is really so deleterious to the cables or insulation as it is generally supposed to be. The unanimity of authorities on fire risks, &c., on this point is so striking, that we are inclined to be somewhat sceptical as to its validity, but having invariably used resin for the purpose, we are unable to point to any instance of good or bad results with soldering fluids—which are generally more or less closely related to zinc chloride. We should be glad to receive particulars of actual experience gained with these fluids, *pro* and *con.*, from any of our readers who have been bold enough to transgress the resin regulation.

Venice turpentine was advocated for the purpose many years ago. Is it ever tried now?

A correspondent writes:—"As a reader of the REVIEW for some years now, I would be much obliged if you, or any of your readers, could let me know of a special fitting that is made suitable for a baker's oven. The lamp will have to stand over 500°, and the fitting would have to be very strongly put together. A reply through your columns would greatly oblige."

[Perhaps some of our readers can assist the writer of the above.—EDS. ELEC. REV.]

HELD OVER.—Owing to pressure upon our space, several letters are unavoidably crowded out this week.—EDS. ELEC. REV.

WIRELESS TELEGRAPHY v. SUBMARINE CABLES.

II.

AFTER last week's article had gone to press we noticed in the daily papers that Mr. Carnegie was about to interest himself commercially and scientifically in Mr. Marconi's inventions. This would doubtless be a good thing for his Wireless Telegraph Company if, as we understand, an appeal to the public for further funds is imminent, and as for Mr. Carnegie, he can well afford to indulge in anything that takes his fancy.

E

According to an American scientific journal, Mr. Marconi's experiments are somewhat costly, each mast 130 ft. high meaning the expenditure of $1,200. He proposes to build towers for permanent stations, as masts are so troublesome, and he does not see why the rate for trans-Atlantic messages should not be reduced to 1 cent a word in future.

Marconi will have to send more words a minute than he can transmit at present, or his expenses will, we think, exceed his receipts, judging from the amount of electrical energy he has to expend in his wireless signalling; a matter to which we referred at some length in our issue of the 3rd inst. Continuing the expressions of opinion given in our previous article by men whose lives have been mainly devoted to submarine telegraphy, Sir Henry Mance says that, considering the advertisement which has been given to Mr. Marconi by the Anglo-American Cable Company, one can hardly be surprised that shareholders in submarine cable stocks should feel a little nervous about their investments. It is to be hoped, however, they will have the good sense not to be in too great a hurry to sacrifice their holdings. That wireless telegraphy has come to stay must be perfectly clear to anyone; that it will be extremely useful in certain cases, there can be no doubt; but he declines to believe that it will ever be a commercial rival to any submarine cable of moderate length. No individual or company can monopolise the ether; the systems failed during the yacht races in New York because neither station would give way for the others, and he believes somewhat similar results have been observed on board His Majesty's fleet when experimenting with wireless telegraphy. He does not doubt that some sort of signal was received by Mr. Marconi during his recent experiments on the other side of the Atlantic, but he mentions, for the information of those interested, that the earth current variations in a long submarine cable frequently produce a signal resembling the letter "S." The selection of this letter by Mr. Marconi for use in his experiment was, therefore, rather unfortunate.

The dream of our philosophers of old has been realised, concludes Sir Henry, but whether there is any money in it is quite another question.

Mr. Willoughby Smith, of the Gutta-Percha Company, writes :—

"Mutual adjustment to prevent interference may be possible, and, I am told, has been successfully tried with two, or perhaps three, sets of apparatus working in great proximity, but this is very different from the fine distinction in wave lengths necessary for the intermingling multitude which would be required to take the place of existing submarine cables; and I cannot see how any laws or patents could prevent intentional disturbances.

"If for the moment we reverse the situation and assume that wireless telegraphy was originally introduced, so that we had for the last 50 years known no other method, I am confident that the invention of submarine cables, with their direct connection, consequent privacy, and ease of working, would be hailed as an enormous advance and improvement upon the older method."

This assumption, as our readers will remember, was also brought forward by one of our correspondents in the article we published last week.

Mr. John B. Hooper, of Hooper's Telegraph Company, expresses himself in the following manner :—

"The success of the submarine telegraph service, especially over-sea messages, is dependent upon accuracy and speed of transmission and secrecy. With code messages the risk of mistakes being made is greater, but the errors on the submarine lines are, comparatively speaking, few.

"The cost of transmitting messages is largely due to the expenses incurred (beyond the interest and sinking fund on the prime cost of the submarine cables) for collating, transmitting, receiving and distribution, and the general expenses of a telegraph company. These expenses would apply to the wireless telegraphy, and would fall more heavily on any retardation of speed in transmission.

"I believe the speed now attained in working through the cables laid in the North Sea is (by the duplex system) 80 words per minute, though this may be exceptional as compared with other systems. A business man will be prepared to pay for speed and accuracy and secrecy, and so far as the Marconi wireless telegraphy has been worked, I do not see any likelihood of the business of the submarine telegraph companies being interfered with.

"Referring to Palmer's index of the *Times* for the three years 1877—8, when the electric light was first introduced, we find recorded on July 7th and 9th, 1877, 'Heavy Fall in Gas Shares,' and on October 11th and 12th, 1878, 'Notes on Panic in Gas Shares.' Referring to Mr. James N. Shoolbred's Papers in 1878—9, as published in the Reports of the British Association for those years 'On the Present State of Electric Lighting,' 1877, and 'On Recent Advances in Electric Lighting,' 1878, and comparing the more or less perfect systems of electric lighting and motive power of to-day with the systems then in use, one would have expected the gas industry to have been annihilated. Instead of this I read lately a statement in a weekly electrical paper as follows :—

"'Electric lighting dates for all practical purposes from 1890, and gas lighting from about 1810. And yet, after a commercial existence of nearly a century, we find the gas industry of the United Kingdom still advancing at such a pace that the mere annual increase of its income is greater than the total income derived from the sale of electrical energy all over the country.'

"My belief is the submarine cable companies will do as well in the future as the gas companies have done hitherto."

Mr. J. T. Wilmot, of the Commercial Cable Company, writing from Waterville, says :—

"In reply to your inquiry, I am very strongly of the opinion that the scare amongst the holders of submarine cable stocks is not at all warranted by anything yet accomplished, or in view of being accomplished, in the near future in wireless telegraphy. Admitting that Mr. Marconi, when in Newfoundland, actually succeeded in catching the signals from the Lizard, as he claims to have done, but which, as a fact, still remains to be demonstrated, that is a very small step towards the practical success to be reached before the existing cables can be considered in jeopardy, and, until something very much more tangible is arrived at, I think holders of cable stock need not feel the least alarm.

"What does Mr. Marconi claim to have done? He prearranged that at certain times on certain days the Lizard Station was to transmit the signals representing the three dots of the Morse 'S.' He was not able to get anything in his coherer, which would be of the most delicate pattern his extensive experience would enable him to make; but, by connecting a telephone to his kite line, he asserts that he could distinguish these. Possibly he is correct; these signals are of such a character that they would carry if anything would. You or I could not have detected them. It was only his highly trained ear that could do so. How extremely frail was, therefore, his result, and how easily might the same have been produced by the numerous local causes which we all know so well affects the delicate little telephone. What an enormous gulf separates these little uncertain sounds heard or fancied in a telephone from the conditions that must be reached before the system can approach a commercial basis.

"We have read of the failure of the Marconi apparatus in South Africa, owing, I believe, it is stated, to the mountainous nature of the country. It is evident that communication is possible over much longer distances at sea than on land, but it seems to me inconceivable that what could not be applied through comparatively short distances in South Africa should on another part of the earth's surface surmount what, owing to the earth's curvature, amount practically to an enormous mountain, as Prof. Fleming says, 110 miles high, only three of which are water at the point of its greatest depth, and make its influence manifest all those hundreds of miles apart, even although the upper strata of the atmosphere or the ether beyond may possibly act as a resonator and assist the propagation and deflection of the waves. I need scarcely remind you how far short of all this the communication with shipping at sea has fallen.

"Before there can be any attempt made to compete with the cables, there are three far-reaching conditions necessary that must be attained by our 'wireless' friends after they have succeeded in passing plain, intelligible signals across the Atlantic, which, mark you, they have not yet done; and these are, first, to produce a means of absolutely confining a

Marconi message to the particular receiver for which it is intended, to the exclusion of all eavesdroppers; second, methods of syntony will be essential that will enable an indefinite number of lines to be worked in both directions at a good speed; third, a monopoly of the particular wave lengths that are essential to them, to prevent any rivals from setting up rival apparatus for producing rival waves, and so upsetting the whole apple-cart. None of these are in sight.

"I have had a considerable experience in telegraphy, and in the light of that experience, have no hesitation in giving it as my opinion that the cables are going to hold their own as a reliable and rapid means of communication.

"That wireless telegraphy has a vast field of usefulness before it is undeniable, but I can see nothing in any of the results so far achieved by it that need alarm cable shareholders."

Mr. John Rymer-Jones, one of the ablest cable experts known to us, sends his views of the situation in the following terms:—

"That atmospheric or other stray electrical discharges should have produced on the Newfoundland receiver several repetitions of 'S' at the time when this particular letter was being sent by arrangement from the Lizard Station, or that one so expert with his own apparatus as Mr. Marconi should mistake outside disturbances for actual signals, seems as improbable as that a wireless system known to have worked successfully for the hitherto record distance of 186 miles should be incapable of showing some faint evidence at least of its far-reaching influence even to a distance of 2,170 statute miles, notwithstanding that the aerial conductor for the 186 miles (between St. Katherine's Point, Isle of Wight, and the Lizard) consisted of four parallel wires, instead of only one, and the height (48 m.) apparently much greater in proportion than that at the Newfoundland end. On the other hand, the evidently spasmodic and feeble nature of the three equal impulses received at equal intervals of time, and forming one of the most simple letters to record, scarcely justifies the scare which has possessed nervous cable shareholders.

"In view of the marvels achieved by wireless telegraphy, the rapidity of the progress already made, and reasonable probability of further improving the system, it is natural that holders of cable stock should be prepared for further wonders, and be a little uneasy on the strength of Mr. Marconi's sanguine expectation that regular signalling will be possible when the electric impulses emitted from the Lizard Station are increased in intensity; but it is scarcely necessary to point out that receiving a succession of simple letters like 'S' is a very different thing to a practical system, which, before it can prove a really serious rival to cable telegraphy, must combine the all-important considerations of speed, reliability, and secrecy.

"That wireless telegraphy has special and most important uses for military and naval purposes, in the mercantile marine, between lighthouses and lightships and the shore for short distances where cables cannot be employed, or even for considerable distances where comparatively slow speed of signalling suffices, is fully recognised; but that it will be a dangerous competitor with either short or long cables employed for important commercial work is highly improbable. Short cables can be operated with automatic senders at a very much higher speed, and worked duplex, quadruplex or multiplex, if required, to meet the congested traffic. The cables last laid across the Atlantic for the Commercial and the Anglo-American Cable Companies are capable of being worked 45 words a minute simplex, and double that speed duplex.

"The speed attained by wireless telegraphy, even for short distances, is only some 24 words a minute, and although with the syntonic system Mr. Marconi says 'we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers. Different messages can be sent by each transmitter connected to the same radiating wire simultaneously, and received equally simultaneously by the vertical wire connected to differently tuned receivers.' I do not find that he has at present accomplished this even between the Lizard and St. Katherine's stations, and multiplex wireless telegraphy of this kind is widely removed from merely receiving the letter 'S' across the Atlantic at the maximum speed of 32 times a minute, which is all that Mr. Marconi claims to have accomplished, so that shareholders may with safety possess their shares in patience for the present.

"But apart from the question of speed, it is not yet proved that wireless telegraphy across the Atlantic will be a practical—not to mention a commercial—success, even if the receiver can be made to record words. Many an instrument which will compass, under favourable conditions, the object for which it was designed, has been discarded, owing to the difficulty of keeping it in perfect adjustment. Possibly it is owing to the already extreme sensitiveness of the receiver, and the greater disturbance to which it would be subject if made still more sensitive, that Mr. Marconi prefers to increase the energy of the transmitted waves as being more promising. As signals so far received were feeble and uncertain, it will doubtless require a considerable increase in energy to produce signals, not only legible, but reliable for commercial code working.

"Again, if wireless telegraphy across the Atlantic be made practicable, these stations will be multiplied, which will at the same time multiply disturbing centres, and help to safeguard the interests of cable companies. Mr. Marconi says that the old non-syntonised system is doomed, and must give way to the syntonised, because the former 'keeps picking up messages from various sources, which very often render unreadable the messages one is trying to receive.' The syntonised method was, we may conclude therefore, employed between Newfoundland and the Lizard.

"Mr. Marconi further says: 'If we are working with oscillations which differ very considerably in period, a transmitter capable of sending signals 31 miles to a tuned receiver, will not affect a non-tuned one at 50 metres.' 'If the period of the two tunes are more similar to each other, then the non-tuned receiver may be affected even at several kilometres.' Clearly, therefore, the existing numerous non-syntonised installations are destined to be changed to syntonised ones, and then 'the ether (will) become, in consequence of great wireless activity, exceedingly lively,' as Mr. Marconi says is at present the case in the English Channel; and all stations having tuned receivers and transmitters which happen to have periods of oscillation approximating those of other stations, may be expected in some degree to interfere with each other's signals, and especially would the stronger Atlantic signals affect local systems of similar pitch on the two coasts. The range available for tuning purposes is probably restricted to one octave, so even the syntonised system does not promise to be altogether proof against extraneous disturbances. As to secrecy. What is to prevent the actual period of oscillation of any station being adjusted to by an enemy, or evilly disposed person, and messages being read; or, the period being once found, signals being intentionally sent to confuse communication? With the disappearance of cables would go all idea of a pan-British system of telegraphy. For these reasons even syntony does not appear destined to permit wireless messages to compete successfully with submarine telegraph messages, the contents of which are known only to those working the cable.

"For competing with cables to the East, the prospects of wireless telegraphy are even less favourable, owing to intervening obstructions, not presented by the open seas, and wireless installations.

"Even more than telephony, the proved capabilities of wireless telegraphy are sufficient to impress the imagination and dispose the public mind to believe in its unlimited possibilities; but speaking by means of the former is limited by known laws, and it is probable that the latter will turn out commercially impracticable for long distances, the liability to interference and want of secrecy, being among the chief obstacles to wireless telegraphy superseding submarine cables."

The *Financial Times*, on Monday, devoted a leading article to this subject—a sort of sitting on the fence editorial. There may, or may not, be a serious rivalry between wireless telegraphy and submarine cables, according to our contemporary, but it is certain that the danger is not imminent.

In order that the *Financial Times* may feel assured that

this rivalry is neither imminent or probable, we commend to the notice of its editor the expert opinions of eminent electricians published in our last issue, and the further testimony to the future stability of submarine cable enterprise, which we are enabled to present to our readers to-day, in addition to our own leading article. But the depreciation in the value of the shares of cable companies is a most extraordinary one, ranging from 25 per cent. to nearly 70 per cent. in the better known stocks. The following table from our financial contemporary's article shows at a glance how the shares have steadily fallen during the past two years:—

Stock.	Highest, 1899.	Highest, 1900.	Highest, 1901.	Latest.
Anglo-American Telegraph ordinary	69	67½	56½	48½
Anglo-American preference ordinary	120⅞	117⅝	102	90½
Anglo-American deferred ordinary	18⅜	17 15/16	11⅞	8
Direct U.S. Cable	12¾	12⅜	11½	10
Eastern Telegraph	188	159	151	130
Eastern Extension Telegraph	18⅝	16½	14¾	13
Indo-European	60	58	50	40
Western Telegraph	—	15¼	15	12½

It accurately reflects, says the City paper, the degree of success which has attended the experiments of "wireless" enthusiasts.

To us it rather reflects the wish which is father to the thought, for if the attempt at signalling the letter S across the Atlantic was merely, as has been stated, for the private ends of Marconi's Wireless Telegraph Company, why was the matter publicly "boomed" the next day throughout the length and breadth of the land for all it was worth!

Our contemporary sees no chance of submarine telegraph shares recovering the market value they possessed in 1899 within any reasonable period. They may experience a partial recovery, but since the fear of successful competition which depressed them cannot be entirely allayed, it is unreasonable to look for the entire removal of its influence.

The *Financial News* is, no doubt, correct in the main, but the upshot will probably be a recurrence of what took place with gas shares in 1879, to the manifest advantage of those who are now bold enough to put all the money they can spare into cable stock.

PARLIAMENTARY.

Mr. Jeune and Mr. Campion, the Examiners of the House of Commons, sat on Saturday to examine private Bills for proof of compliance with Standing Orders. The following Bills came before Mr. Jeune:—

Bradford Corporation.—This Omnibus Bill of the Bradford Corporation gives the Corporation, amongst other things, power to construct 13 sections of tramway, the most important sections of which are:—No. 1, 2 miles 7 furlongs 8 chains; No. 2, 1 mile 5 furlongs 8 chains; No. 4, 1 mile 5·40 chains; No. 5, 1 mile 2 furlongs 5·35 chains; No. 11, 1 mile 1 furlong and 6·20 chains; and No. 12, 1 mile and 4·80 chains. The only tramway outside the city is part of No. 3, a portion of which is in the Urban District of Shelf. Part VIII. of the Bill empowers the Corporation to purchase the undertaking of the Shelf Tramway Company. The estimates in the Bill allocate £184,248 for tramways, and £3,000 for electrical purposes in connection with tramways. There was no opposition, and the Bill was passed.

Leicester Corporation.—Under Part II. of the Bill of the Leicester Corporation, power is sought to reconstruct the tramways taken over from the tramway company, and to work them electrically. Power is also taken to purchase tramways outside the borough, which are parts of the existing system by agreement. Land is scheduled in the Bill for a generating station. The Bill was ordered to go forward.

Preston Corporation.—Amongst the various powers sought to be conferred on the Mayor, Aldermen, and burgesses of Preston by this Bill, is that of constructing additional tramways in and adjacent to the borough. There are 15 miles of new tramways proposed to be laid in the borough and in the neighbouring urban district of Fulwood. Standing orders were found to have been complied with.

Brompton and Piccadilly Circus Railway.—This is a Bill to confer further powers on the Brompton and Piccadilly Circus Railway Company for the construction of new railways and works, and for the use of part of the Metropolitan District Railway; to extend the time for compulsory purchase of land and completion of works; and to authorise working and other agreements with other companies, &c. The principal work for which power is sought is the construction of a tube railway, 2 miles 3 furlongs and 2 chains in length, commencing in Kensington by a junction with the line already authorised, and terminating at Fulham by a junction with the Metropolitan District Railway near Parson's Green Station. There is also to be constructed a line 6 furlongs 3 chains in length, to join up the authorised line with the Great Northern and Strand Railway at Little Queen Street, and also a line 5 furlongs 7·80 chains from Ann Street to Charing Cross. A small extension will be made at Piccadilly. A subway is to be constructed at Piccadilly Circus. Another important part of the Bill empowers the company to enter into agreements with the Metropolitan District Railway Company by which the Piccadilly Company may construct the deep level electric line to the City which the Metropolitan Company have already the authority to undertake. Then there are clauses for the Great Northern & Strand Railway Company transferring the powers they obtained under their Act of 1899 to the company, and also clauses to empower the Brompton & Piccadilly Company to enter into working and traffic agreements with the Metropolitan District Company, the Baker Street & Waterloo Railway Company, the Charing Cross, Euston & Hampstead Railway Company, the Great North & Strand Railway Company, the Great Northern Railway Company, the South-Eastern Railway Company, and the Central London Railway Company. If the clauses for transferring the Great Northern & Strand Company are authorised by Parliament, the name of the company will be changed to the "Great Northern, Piccadilly, & Brompton Railway Company." Sanction is asked to raise additional capital not exceeding £2,100,000. Standing Orders were found to have been complied with.

London County Council (Tramways and Improvements).—A Bill to enable the London County Council to construct new tramways in the County of London, and to work the same by electric traction; to make street improvements; to acquire lands for a station for generating electricity for use in connection with their tramway undertaking. The estimated expenditure on tramways and generating station is £1,212,400, and on street improvements £1,390,806. The generating station will be at Greenwich. The Bill was opposed by the Metropolitan Borough Council of Wandsworth. The Examiner passed the unopposed portion, and ordered the opposition to the opposed portion to be held on February 10th.

Northumberland Electric Tramways.—This is a measure to empower the Northern Counties Electric Supply Company, Limited, to construct tramways and tramroads from Morpeth to Bedlington; Bebside to Blyth; and Ashington to Newbiggin, and to make certain street undertakings, &c. The first of these lines is 7¾ miles in length; the second 3½ miles, and the third 4¾ miles. The company proposes in the course of its work to widen the road wherever it is desirable, and the convenience of the traffic, and at no fewer than 38 points along the routes proposed is thus found to be necessary. The other powers asked for are the usual ones sought in the case of tramway companies. The company is to take its electrical supply from the local authorities, while the local authorities are able to give such a supply, but the period at which the local authorities will be able to purchase the undertaking is sought to be extended from 21 years to 42 years. Portions of the Bill were opposed by Richard Guy Lindsay on the ground of non-compliance with standing orders, and the Examiner postponed these portions till February 10th.

After going through the unopposed parts, the following Bills came before Mr. Campion:—

Cornwall Electric Power Bill.—The object of this Bill is to incorporate and confer powers upon the Cornwall Electric Power Company. The capital will be £450,000, and the first directors, Messrs. F. H. Lewis, C. Foster, and C. Wethered. The area of supply is the whole of the County of Cornwall, exclusive of the Scilly Islands and the rural district of Stretton and Holsworthy. The usual clauses of power companies are included in the Bill. Lands for generating stations are scheduled at St. Blazey and Phillack. The prices to be charged are:—(1) The standard charge for service at the rate of 10s. per kilowatt for the supply of which the company is required to make provision; (2) in addition a charge for current determined by meter after transforming as follows:—*(a)* For the first 20,000 units consumed in any quarter at the rate of 3d. per unit; *(b)* for all units consumed between 20,000 and 50,000 in any quarter at the rate of 2d. per unit; *(c)* for all units consumed between 50,000 and 200,000 in any quarter at the rate of 1d. per unit; *(d)* amounts over 200,000 units consumed in any quarter at the rate of ¾d. per unit. Standing Orders were found to have been complied with.

North and South Shields Electric Railway.—Power is taken in this Bill to incorporate and confer powers upon the North and South Shields Electric Railway Company to enable the company to give improved facilities of communication across the River Tyne between North and South Shields. The suggested railway is between 6 and 7 furlongs in length, commencing in Tynemouth and terminating in South Shields. Land is scheduled for the erection of a generating station. The capital is £180,000, and the total estimated cost of the scheme is £172,397. The Bill was passed.

Charing Cross, Euston and Hampstead Railway (No. 3).—A Bill for conferring further powers on the Charing Cross, Euston and Hampstead Railway Company with respect to their undertaking; for authorising agreements with the Metropolitan District Railway Company, the Baker Street and Waterloo Railway Company, and for other purposes. Power is given to extend the time for the purchase of land and the acquisition of additional land. It amends Railway No. 1 authorised by the Act of 1893, and gives power to raise £300,000 additional capital. There was no opposition on Standing Orders, and the Bill went forward.

City and North-East Suburban Electric Railway (No. 2).—It is proposed in this Bill to give effect to the suggestions of the Joint

Committee on Tube Railways which sat last session. The capital is £3,000,000, and land is proposed to be taken in Low Leyton for a generating station. Standing Orders were found to have be complied with.

Donegal Railway.—A Bill for attaching a preference to the capital to be used for the Ballyshannon extension; for the consolidation and conversion of the capital of the company; to repeal the provisions of former Acts as to separate undertakings; to further extend the time for the completion of the Ballyshannon line; and to authorise the company to work its undertaking by electricity. Power is taken to erect a generating station on certain lands belonging to the company. The Standing Orders were found to have been complied with.

London and Brighton Electric Railway.—The scheme set forth in this Bill is to construct an electric railway between London and Brighton at a cost of £7,338,403. It is proposed to accomplish the journey between the two places in about half an hour, and to afford the public an opportunity of travelling at cheap rates—viz, 3s. third class and 5s. first class return. There will be a half-hourly service during the day. The capital is to be £9,000,000, and the first directors are Mr. F. E. Barnes, Mr. Harding Cox, Sir H. E. Knight, Sir W. Treloar, and three others. There were eight memorials against the Bill, which were given in the ELECTRICAL REVIEW of January 17th. The Examiner decided for the convenience of the parties that the consideration of memorials should be postponed until Thursday, February 6th.

On Monday the following Bills, amongst others, came before Mr. Cannon for proof of compliance with Standing Orders of the House of Commons:—

King's Road Railway.—This was the Bill suspended from last Session when it was before the Joint Committee on Tube Railways. It was proposed to construct a tube railway commencing at Eel Brook Common, Fulham, whence it will run through a densely populated district, of which King's Road is the main artery, and it will finish at Victoria. The Joint Committee in their report stated that this Bill might be referred to a Committee in the ordinary way, but that an extension to Putney was desirable, as well as an interchange station at Victoria, and these recommendations the promoters are meeting this Session by the King's Road Railway (Putney Extension) Bill, which will come before the Examiner on January 23rd. Standing Orders were found to have been complied with.

West and South London Junction Railway.—This was another Bill which was suspended from last session, having been before the Joint Committee on Tube Railways. The proposed railway consists of four sections. The first will be from Bishops Road, north of Paddington station, to the Marble Arch; the second section will be from the Marble Arch to Victoria; the third is from Victoria to Vauxhall; and the fourth will run from Vauxhall and terminate in the Camberwell New Road. There will be an interchange station with the King's Road Railway at Victoria, and there will be subways at Paddington and Victoria. The generating station will be at Camberwell. The Joint Committee made no recommendation with regard to this measure except that it might be referred to a Parliamentary Committee in the ordinary course. There was no opposition on Standing Orders, and the Bill will accordingly go forward.

Great Northern and City Railway.—In this Bill it is sought to confer further powers on the Great Northern and City Railway Company, and to extend the time for the completion of the authorised railway. It is proposed to construct the following works:—(1) A railway 1 furlong 9·12 chains in length, commencing in Coleman Street, by a junction with the authorised line and terminating in Moorgate Street; (2) a circular subway for foot passengers at Lothbury; (3) a conduit in Shoreditch from the lands authorised to be used as a generating station to connect the generating station with the authorised railway. Power is also sought to take further land in Shoreditch for a generating station; to enlarge the tunnels at Highbury for the purposes of erecting a station, and to take land for the necessary approaches; to take land in Coleman Street, West Street, Finsbury Pavement, and Finsbury Circus for extending their stations, sidings, and other accommodations; and to raise additional capital not exceeding £450,000. There being no opposition, the Examiner found proofs of Standing Orders proved.

Dartford Improvement Bill.—Amongst the various powers sought to be conferred on the Urban District of Dartford by this measure, is authority to make further provision with regard to the electric light undertaking; to construct on certain lands a generating station; to supply electric meters and fittings, and to enter into agreements to supply energy in bulk to outside authorities. Standing Orders were found to have been complied with.

Metropolitan Railway.—Under this Bill the Metropolitan Railway and the Harrow and Uxbridge Railway Company are empowered to execute further work, and to acquire additional lands for the enlargement and improvement of the Baker Street Railway. They are also authorised to acquire lands for generating electricity for the electrical working of their system in which they are jointly interested with other companies. The lands sought to be taken for a generating station are situated in the parish of Willesden, on the south side of the railway of the company, and adjoining their locomotive and carriage works, and the River Brent. Clause 28 enables the company to enter into and carry into effect arrangements with the South-Western Railway respecting the laying down of electrical mains along that railway between Richmond Junction and new Richmond Station, and they may enter into similar arrangements with the West London Company for the carrying of lines along that line. Clause 30 will enable the company to work by electrical power the traffic upon the Hammersmith and City Railway, and Clause 31 empowers the company and the Great Western Company to carry out the necessary work. Clause 34 enables an agreement to be made between the company and the Metropolitan District Company as to the electrical working of the traffic on the East London Railway. Clause 39 states that when the railways of the company forming part of the Inner Circle Railway have been completed and adapted for electrical traction, the company may, by notices in writing, require all companies running over and using such railways to use electrical traction instead of steam traction, and such companies shall conform to the requirements and adapt their carriages and other rolling stock for haulage by electrical power. Standing Orders were found to have been complied with.

Baker Street and Waterloo Railway.—By the Act of 1893, the company was authorised to construct a tube railway and raise £1,250,000 capital and borrow £416,000, and in 1896 and 1899 the company was empowered to make extensions, and in 1900 to raise £1,000,000 additional capital. The company has already expended £345,203 in the purchase of land and £599,499 in the execution of works. They now ask under this Bill for an extension of time to August 1st, 1904, for the purchase of lands authorised by the 1899 Act, and an extension of time for the completion of the works till August 1st, 1905. Certain alterations in the Acts of 1893 and 1900 regarding the raising of money on mortgage are also sought for. The necessary proofs of compliance with Standing Orders were given by the agents, Messrs. Burchells & Co.

Finchley Improvement.—This Bill authorises the Urban District Council of Finchley to make further provision with regard to the electric light undertaking. Power is taken to erect a generating station on certain lands; and also an extension of time for laying mains in the compulsory area. There are certain amendments proposed in the Bill of the Finchley Electric Light Order, 1899, and power is taken to supply electric energy in bulk outside the district. Messrs. Baker, Lees & Co., the Parliamentary agents for the Bill, proved compliance with Standing Orders.

Cleethorpes Improvement.—Various powers are sought in this Bill, and amongst them is authority for the Urban District Council of Cleethorpes, in the County of Lincoln, to construct and work tramways and to make further provision with regard to the supply of electricity. It is proposed to make a tramway 3 furlongs odd in length, commencing in High Cliff Road, by a junction with the existing tramway of the Great Grimsby Street Tramways Company, and to make agreements with that company for the working of the tramway. With regard to electricity, power is sought to purchase a generating station and plant from the Great Grimsby Street Tramways Company. In the estimates, £5,000 is allocated for the tramway and £25,000 for the electric undertaking. Standing Orders were found to have been complied with.

Exeter and District Tramways.—A Bill for incorporating and conferring powers on the Exeter and District Tramways Company, and empowering them to construct tramways in Exeter, the urban district of Heavitree, and the parishes of Alphinston and Rhaston. The capital of the company will be £175,000.—It was decided to postpone the examination of this Bill till February 10th.

Charing Cross, Hammersmith, and District Electric Railway.—Authority is asked under this Bill for the Charing Cross, Hammersmith, and District Electric Railway Company to construct underground lines from Hammersmith to Barnes; from the West Strand to the River Thames; from the Strand to Piccadilly Circus; and from Piccadilly Circus to Hyde Park Corner, and to raise additional capital not to exceed £1,200,000. Standing Orders were found to have been complied with.

Croydon and District Electric Tramways—A big tramway scheme is proposed in this measure, which is promoted by the British Electric Traction Company, who ask for authority to construct tramways in the counties of London, Surrey, and Kent. The Bill provides for the construction of tramways in the districts of Croydon, Sutton, Mitcham, Penge, and Beckenham, and in all 25 lines are specified. Land is proposed to be taken at Sutton for a generating station. Memorials were presented against the Bill by the London County Council, the Croydon Corporation, the Croydon Urban District Council, and the Beckenham Urban District Council. It was decided to postpone the examination of the Bill till February 10th.

THE following Bills came before Mr. Jeune for proof of compliance with Standing Orders on Monday.

City and North-East Suburban Railway.—The above Bill was suspended from last Session, having been before the Joint Committee on Tube Railways. It is proposed to construct a line from Bishopsgate Street to Waltham Abbey, *viâ* Shoreditch, Victoria Park, Hackney Marshes and Lower Leyton, and Walthamstow. The entire length of the proposed line is 14 miles. In their report the Joint Committee make various recommendations with regard to the line, and these recommendations will be met by a further Bill being introduced this Session. Standing Orders were found to have been complied with.

South Shields, Sunderland and District Tramways.—This Bill is to authorise the British Electric Traction Company, Limited, to construct tramways between South Shields and other places. The tramways for which authority is asked are 10 in number, of varying lengths. With regard to the purchase of the undertaking by local authorities, Sec. 28 seeks to modify Sec. 43 of the Tramways Act of 1870 by substituting a period of 42 years for the period of 21 years mentioned in that section. The examination of the Bill was deferred till February 10th.

Torquay and Paignton Tramways.—A Bill to authorise the construction of tramways in the Borough of Torquay and the Urban District of Paignton in the County of Devon, &c. This Bill seeks to incorporate a company to construct tramways in the Borough of Torquay and the Urban District of Paignton, and the tramways

for which power is sought are nine in number. The most important is No. 1, a little over 5 miles in length; while No. 2 tramway is 4 miles 5 furlongs odd in length. No. 3 tramway is 1 mile 2 furlongs in length, but all the others are short lengths. The authorised capital of the company will be £160,000, and the first directors will be Joseph Browne, Martin, Arthur Greenwood, Henry Claude Walker, Robert Arthur Smith, and three others. The tramways will be run by electric power. With regard to the purchase of the undertaking by the local authorities, it is sought to substitute 35 years for the period of 21 years mentioned in the Tramways Act of 1870. The examination of the Bill was postponed till February 10th.

Rhondda Urban District Council Tramways.—The chief provisions in this Omnibus Bill of the Urban District Council in the County of Glamorgan empowers the Council to construct and make tramways. The estimates of the Bill include £162,000 for the construction of tramways and for tramway purposes, and £131,000 for generating stations and electrical equipment of tramways and traction works. Nine sections of tramways are set forth in the Bill, the total length being about 20 miles. Power is taken to take certain land in the parish of Ystradyfrodwg for a generating station. The necessary proofs of compliance with Standing Orders were adduced.

North Ormesby, South Bank, and Grangetown Tramways.—A Bill for incorporating the North Ormesby, South Bank, and Grangetown Tramways Company, and for other purposes. The capital of the company is fixed at £54,000, and five lengths of tramway set forth in the Bill are to be constructed. Power is also taken to take land for generating station. The examination of the Bill was postponed till February 10th.

The following Bills came before the Examiner of Standing Orders on Tuesday for proofs of compliance with Standing Orders.

Central London Railway.—Under this Bill the Central London Railway Company seeks powers to construct new railways, &c. The proposal is to construct a railway between Hammersmith and the City with connection with the existing railway of the company, and to raise additional capital, not exceeding in the whole £3,000,000. The Standing Orders were found to have been complied with.

Metropolitan District Railway.—A Bill for empowering the Metropolitan District Railway Company to lay down and maintain substituted mains for electrical energy, and to work certain railways by electrical energy, to acquire lands, to extend the time for the completion of certain railways, and compulsory purchase of lands, to constitute the railway authorised by the Metropolitan District Railway Act, 1897, a separate undertaking, to raise further capital, and for other purposes. The Bill contains various powers, viz.: To deviate the line of cables connecting the company's generating station at Lot's Road, Chelsea, with the company's railway at Earl's Court, and to acquire additional land therefor, and for the generating station. To enter into agreements as to the laying of cables along the West London Extension Railway. To abstract water from the River Thames, and return same. To work by electrical power (*a*) portions of the London and South-Western Railway between Turnham Green and Richmond, and between Putney Bridge and Wimbledon; (*b*) East London Railway; (*c*) Hounslow and Metropolitan Railway. To provide that, the guaranteed stock to be issued by the company under Sec. 26 of the Whitechapel and Bow Railway, October, 1900, shall be known as Metropolitan District (Bow Extension), second guaranteed stock, and shall rank for dividend after the Metropolitan District (Bow Extension) guaranteed stock issued under the Whitechapel and Bow Railway Act, 1898. To raise additional capital. To constitute the Deep Level Railway authorised by the Metropolitan District Railway Act, 1897, or any part thereof, into a separate undertaking. To extend the time for the construction of the Deep Level Railway, and the purchase of the lands therefor. To extend the time for the sale of surplus lands. To run over the portion of the London, Tilbury and Southend Company's railway between Campbell Road and Barking by agreement with that company. To amend an agreement of July 18th, 1901, between the Metropolitan District Electric Traction Company, Limited, and the company. The necessary proofs of compliance with Standing Orders were given.

Edgware and Hampstead Railway.—A Bill for incorporating the Edgware and Hampstead Railway Company and for empowering them to construct railways partly underground from Edgware to Hampstead. The railway No. 1 is 4 miles 4 furlongs and 3 chains in length, and commences in Edgware, near the entrance to Edgware Station and terminates in Hendon. No. 2 is 1 mile 3 furlongs and 5·80 chains in length, which continue to railway No. 1 and terminates near to the North London Hospital at Hampstead. The capital of the company is £400,000, and the first directors are to be Messrs. Highley, A. Stirling, and W. K. Trotter. The railway will be worked in connection with the Charing Cross, Euston and Hampstead Railway. The Standing Orders were complied with.

LEGAL.

The Madeira Electric Lighting Company, Limited.

In the Chancery Division of the High Court of Justice on 17th inst, before Mr. Justice Byrne, Mr. Levett, K.C., in this case moved on behalf of the Halifax Joint Stock Banking Company and other debenture holders for the appointment of Mr. John Edward Whitham (chartered accountant, of Halifax), as receiver and manager of the undertaking of the company, on the ground that the interest on the debentures was in arrear for more than six months. The learned counsel stated that the plaintiffs were the holders of 113 debentures, out of 300 debentures of £50 each.

Mr. Justice Byrne made the order as asked, limiting the appointment of Mr. Whitham as manager to three months without further leave from the Court.

Hedges *v.* McKrell & Taylor, Limited.

In the Chancery Division of the High Court of Justice on 17th inst., Mr. Justice Byrne, at the suit of the plaintiffs, who are debenture holders, appointed a receiver and manager of the company's undertaking. It was stated that the company carried on the business of electrical engineers in the Barbican, and that the interest on the debentures had been in arrear since October last. His Lordship referred it to Chambers to appoint a fit and proper person, limiting the appointment of manager to three months without further leave of the Court.

Bruce Peebles & Co. *v.* J. L. Kerr, Limited.

In the Leith Court of Session last week, Lord Stormonth Darling heard an action by D. Bruce Peebles & Co., gas and electrical engineers, of Bonnington, Edinburgh, against John L. Kerr, Limited, carting contractors, of Edinburgh, now in liquidation, for delivery of a 15-H.P. motor supplied in August, 1900, by the pursuers to the defenders. The pursuers' case was that the motor was to remain their property until the price (£99 15s.) was paid, and that, with the consent and concurrence of the defenders, they affixed a plate to the motor, bearing an inscription to the effect that it was the property of D. Bruce Peebles & Co. This plate still remains on the motor. The defence was that the contract, which was formed by letters of offer and acceptance, contained no stipulation that a bill which was to be granted in payment of the price should be met before the property passed, and that therefore, the letters being a conclusive bargain, it must be held that the property had passed, leaving the pursuers merely creditors for the price in liquidation.

The Lord Ordinary gave decree of delivery, with expenses, to the pursuers, holding that the affixing of the plate on the motor, and the words it bore, must be held to be a term of the contract, because the existence of the plate was known to, and was not repudiated by, the defenders' representative. The property therefore did not pass; it still remained the pursuers, who were entitled to delivery.

The Electric Lighting of St. Ermin's Hotel.

In the Chancery Divison on Tuesday before Mr. Justice Kekewich, Mr. Mitchell moved *ex parte* for an interim injunction to restrain the London Electric Supply Company from cutting off the supply of electricity to the St. Ermin's Hotel, Victoria Street, Westminster. Counsel stated that the application was by the receiver of the hotel company who had been appointed on a debenture holder's action. The hotel was being carried on as a going concern, and there were at the present time between 200 and 250 guests in the hotel, so that, as his Lordship might imagine, the sudden stoppage of the electricity supply would cause very considerable inconvenience. The Electric Company had threatened to cut off the supply that morning. It appeared that there was a sum of between £400 and £500 due for electric lighting, but though the receiver had undertaken to pay for the electricity supplied during the time he had been in possession, the Electric Company had refused to accept that offer. His Lordship said he had never heard of a case in which an application of the sort had been made by a receiver, and the learned counsel had better look up the authorities and bring the proper parties before the Court. He should not grant the application in its present form.

Patent Exploitation Company, Limited, *v.* Siemens Bros. and Co., Limited.

This case came before Mr. Justice Buckley in the Chancery Division on Tuesday and Wednesday. The plaintiffs, of Liverpool, sought an injunction and damages in respect of an alleged infringement of a patent for a dry cell galvanic battery. Our report will appear next week.

BUSINESS NOTES.

Auction Sale.—On Tuesday next (28th inst.) Messrs. Skardon, Sons & Hosking will sell by auction at Plymouth, sundry electrical plant, fittings, and accessories, the property of Robinson, Sadler and Co., 20, Ebrington Street, Plymouth, who are retiring from business.

Charge of Stealing Electricity.—At the Bournemouth Borough Police Court last week, Eddy de Behr was charged on a summons with having between December 11th and 26th last feloniously used electricity of the value of 10s., the property of the Bournemouth and Poole Electricity Supply Company, Limited. The case was committed for trial at Quarter Sessions, bail being allowed.

Electrical Wares Exported.

WEEK ENDING JAN. 22ND, 1901.		WEEK ENDING JAN. 21ST, 1902.	
Adelaide. Teleg. mat.	Value £1,300	Amsterdam	Value £268
Amsterdam	135	Barcelona. Teleg. mat. ..	342
Bangkok	225	Bilbao. Teleg. mat.	366
Beira	203	Bombay	130
Bombay	53	Brisbane. Teleg. cable ..	305,000
Brisbane	30	Buenos Ayres. Teleg. mat. ..	46
Calcutta	1,450	Calcutta	425
Colombo	75	Cape Town	198
Copenhagen. Teleg. wire ..	187	Casablanca	13
Durban	358	Channel Islands	109
Fremantle	14	Colombo	319
Gibraltar	14	Copenhagen. Teleg. wire ..	25
Hamburg	68	Durban	785
,, Teleg. mat.	400	Lisbon	60
Havana. Teleg. mat. ..	50	Perth	80
Kobe. Teleg. cable	2,898	Port Chalmers	70
Launceston	365	Port Elizabeth	43
Lyttleton	49	Shanghai	70
Melbourne	80	Stockholm. Teleph. cable ..	106
Nagasaki	632	Sydney	243
Ostend	75	Wellington	1,055
Perth	58	Yokosuka	1,286
Port Chalmers	194		
,, Elizabeth. Teleg. mat. ..	152		
St. Petersburg	67		
Vascho. Teleg. cable	2,740		
Shanghai	167		
Singapore	40		
Sydney	1,967		
,, Teleg. wire	164		
,, Teleph. cable ..	2,150		
Wellington	433		
Yokohama	3,912		
,, Teleg. mat. ..	47		
Total ..	£20,742	Total ..	£311,039

Foreign Goods Transhipped.

Brussels. Elec. goods ..	Value £45	Bombay. Elec. fans	Value £98
Paris. Elec. goods	15	Colombo. Elec. mat.	26
Perth. Elec. apparatus ..	2,350	Rangoon. Elec. goods	23
Total	£2,410	Total ..	£147

Bankruptcy Proceedings.—*Re* Walter Vernon Scott, electrical engineer, 1, Shaftesbury Road, East Hammersmith. This case came on for hearing at the London Bankruptcy Court on Tuesday, before Mr. Registrar Linklater, in connection with an application by the bankrupt for his order of discharge. It was reported that the receiving order was made in July, 1900, upon the petition of a creditor, and that the liabilities amounted to £580 7s. 4d. No assets were disclosed by the bankrupt, but the sum of £33 1s. 2d. had been realised, and a first and final dividend of 3d. in the £ was expected. From 1887 to 1897 the bankrupt was in the employment of a firm of electrical engineer contractors, as an assistant electrical engineer. In April of the latter year the firm by whom he was employed gave up the installation branch of the business, and the bankrupt, with a view to securing the connection, promoted a company—Walter V. Scott & Co., Limited—with registered offices at 118A, Cromwell Road, S.W. He put £200, borrowed money, which was still owing, into the business, and received £1,500 £1 shares in the company, with the appointment of managing director at a salary of £250 per annum. Of the nominal capital of £5,000 only £1,700 was subscribed, of which £1,000 was found in April, 1898, by one Charles Lopdell. The company went into liquidation in November, 1898, and those proceedings had been closed, no dividend or return having been made to the creditors. The bankrupt, after the liquidation of the company, and at the date of the receiving order, was engaged as an electrical engineer. He attributed his failure to his liability under a judgment recovered against him for money borrowed and goods supplied to the company, and to the excess of his expenses over his income during the three years preceding failure. The application was opposed by the Official Receiver on statutory grounds, and his Honour suspended the order of discharge for the minimum period of two years.

February 5th is the last day for the Official Receiver, Mr. A. H. Wildy, Carey Street, to receive proofs for intended dividend in *re* W. V. Scott, electrical engineer, Hammersmith.

Dissolutions and Liquidations.—A petition for the winding-up of Charles Bright & Co, presented by the River Plate Construction Company, Limited, is to be heard at the Law Courts on January 30th.

The North-Eastern Telephone Company, of Newcastle-on-Tyne, is winding up voluntarily with Mr. C. Humble, of Gateshead, as liquidator.

Messrs. W. B. Carrick and J. Anderson (W. B. Carrick & Co., electric light and power engineers, and consulting electricians, Gateshead), have dissolved partnership. Mr. Carrick attends to debts.

Messrs. A. E. Pemberton and W. Rodger (Sale Electrical Company, electrical contractors, Sale, Chester), have dissolved partnership. Mr. Pemberton attends to debts.

The Commercial Telegraph Construction Syndicate meets at 7, Angel Court, E.C., on February 20th, to hear an account of the liquidation proceedings from the liquidator, Mr. C. Quennell.

Books Received.—"Electric Wiring and Fitting," by C. V. Drysdale, B.Sc. London: R. J. Bush. 1901. 3s. net.

"L'Année Electrique," by Dr. Foveau de Courmelles. Paris: Ch. Béranger. 1902. 3 fr. 50 c.

"The Law Relating to Factories and Workshops," by Evans Austin. Second edition. London: Knight & Co. 1901.

"Electrical Engineer's Pocket-Book," by H. A. Foster. London: E. & F. N. Spon, Limited. 1902. 21s. net.

"Wireless Telegraphy and Hertzian Waves," by S. R. Bottone. Second edition. London: Whittaker & Co. 1901. 3s.

"Practical Exercises in Magnetism and Electricity," by H. E. Hadley. London: MacMillan & Co., Limited. 1901. 2s. 6d.

"Exercises in Physics," by C. J. Leaper. London: Biggs & Co., 1901. 2s. 6d.

"Primary Batteries," by W. R. Cooper, B.Sc. London: The *Electrician* Printing and Publishing Company, Limited. 10s. 6d.

"The *Electrician* Wireman's Pocket-Book." Edited by F. C. Raphael. 1902. London: The *Electrician* Printing and Publishing Company, Limited. 5s. net.

Breconshire.—Mr. Watkin Williams, of Pontypridd, has been accorded the contract for installing the electric light at the new asylum which has been built at Brecon. The contract price is £3,500.

Catalogues and Lists.—We have before us several illustrated price lists describing the specialities manufactured by the Boardman Electrical Patents Company, Limited, who, by the way, have removed from 10, Union Court, Old Broad Street, E.C., to 10, Southwark Bridge Road, S.E. The lists show automatic and hand-feed electric arc lamps for photographic, photo-process, stage and medical (lupus cure) work. The "Electrothermogen" is explained in a separate list; it is an apparatus used in hot air and light treatment for curing rheumatism and other ailments.

Hamblet's Blue Brick Company, Limited, of West Bromwich, have sent us circulars relating to their blue ironware pipes, which they claim can be laid at great or shallow depths, without the need of concrete protection, because of their strength, durability, and impermeability.

The American Electric Company, of Detroit, Mich, have issued lists of their Hartwig's combined reflector and protector for incandescent lamps, and their "Anthony" boring tools.

From the British Thomson-Houston Company, Limited, of Rugby, we have received a serviceable glass paper weight, modelled on the lines of an Edison incandescent lamp.

Lists of the Montague card index system are to hand from the Montague Card-Filing Company, of Bride Lane, E.C.

Gast's asbestos air-cell coverings—a modern means for saving steam—form the subject of a small pamphlet now being circulated by Mr. F. J. Gast, of 26, Cortlandt Street, New York.

Mr. Archibald J. Wright, of Upper Street, N., has brought out a new revised and enlarged list of his electric novelties.

We have received from the Tibbington Collieries and Brick Works, Limited, of Tipton, leaflets of their fire brick specialities, and their new patent boiler seating block. Many engineers now desire to fix their boiler on as narrow a space of contact as possible, and this with a very heavy boiler, say, 30 ft. × 8 ft. 6 in., which will weigh 26 tons, is a great weight to fix on two narrow straight lines. It is claimed that Mills's patent boiler seating block will give the desired narrow line, but causes the pressure on the boiler to be spread over a much larger area, and thus prevents internal buckling.

The Keighley Electrical Engineering Company, Limited, of Keighley, have sent us price list and specification of their Keighley motors, enclosed and protected; also a list of the Keighley patent house service fuse boxes; and a neat wall card which gives details and prices of their specialised manufacture of one size of motor.

We have received from Messrs. Mather & Platt, Limited, a copy of the new edition of their steel-clad motor catalogue, which has been considerably revised and enlarged. As misunderstanding has sometimes been caused through it not being definitely stated whether motors are required to be air and water-tight, or protected by a wire gauze cover, or with open ends, an alteration has been made so that this doubt may no longer exist. Motors have been divided under five heads: (*a*) open, (*b*) protected, (*c*) dustproof, (*d*) flameproof, (*e*) entirely enclosed and airtight. The open class motors can be fitted with fine or coarse covers at a small extra cost. As the output of the motor, however, is considerably reduced when hermetically sealed, a special list of prices and outputs for motors of this class has been prepared and included in this catalogue. Messrs. Mather & Platt's series of motors of the open type consist of 11 sizes, covering all powers up to 85 B.H.P., and the choice of the speeds and voltages given is very large. All parts are made strictly inter-changeable, and machines of any size can be delivered from stock at short notice.

Messrs. Montague, Hawnt & Co., of Clerkenwell Road, E.C., and Birmingham, have sent us a copy of their catalogue of vulcanised mechanical india-rubber, asbestos, fibre, and gutta-percha goods.

Messrs. W. R. Renshaw & Co., Limited, of Phœnix Engineering Works, Stoke-on-Trent, have brought out an illustrated list of their "Accessible" water-tube boiler, whose special feature, as its name implies, is that it can be thoroughly inspected and cleaned with the minimum of trouble and unpleasantness. The firm are now manufacturing the land type of this boiler. The catalogue gives some descriptive notes, and details of the standard sizes are given in table form; weight, bulk, composition, heat, and evaporative power of coal and other fuels are also stated.

Copies of their stock list of continuous-current dynamos and motors have come to hand from Messrs. Royce, Limited, of Manchester. Semi-enclosed multipolar and two-polar generators and motors in different sizes, and for different voltages, are held ready for immediate or early delivery.

Messrs. Lobnitz & Co., Limited, of Renfrew, have placed before us an illustrated catalogue of some of the vessels which have recently been completed in their shipbuilding yards; one of the pictures shows a telegraph cable-laying steamer.

The Lahmeyer Electrical Company, Limited, of New Oxford Street, W.C., have brought out a new price list (No. 10) of their shunt and starting regulators for continuous-current dynamos and motors. Illustrations and tabulated data appear regarding shunt regulators for shunt or compound-wound dynamos, starting regulators of the frame type for motors up to 250 volts; starting resistances (box type) with metal contacts for motors up to 250 volts; combined starting and regulating resistances; starting resistances (box type) with carbon and roller contacts for motors up to 500 volts; reversible starters with ditto; combined reversing, starting and regulating resistances for ditto (800 volts) for frequently switching in and out, and for reducing the speed 50 per cent. Liquid starters are also included for continuous-current motors up to 500-volt, shunt, series, or compound wound. The list is excellently arranged and well illustrated.

E.C.C. Dinner.—On Saturday, 11th inst., in the Drill Hall, Wolverhampton, a complimentary dinner was given by Sir Daniel Cooper, Bart., G.C.M.G., chairman of the Electric Construction Company, to those employés who had been in the service of the company for seven years and upwards.

Explosion.—On Thursday last week an explosion occurred at the wagon works of Messrs. Hurst, Nelson & Co., of Motherwell. The electrical installation is said to have been wrecked, and damage to the extent of £1,000 was done.

Fire Prevention.—The British Fire Prevention Committee have arranged for an important test to take place on Wednesday next with a large warehouse floor constructed entirely of Karri and Jarrah wood, the floor being constructed on the same principle as recently adopted for the big warehouses in the new Free Port at Hamburg. There will also be tests with Karri and Jarrah wood doors for comparison with the fire resistance of oak and teak doors.

The executive of the committee announce that the Silver Medal which they offered for the best essay on fire resisting materials exhibited at the International Fire Exhibition of 1901 at Berlin, has been awarded to Lieutenant Elsner, of Berlin.

Grinnell Sprinklers.—We understand that, as near as can be calculated, the record of the Grinnell sprinkler to date is approximately 5,500 fires extinguished at an average loss of about £50 per fire.

May-Oatway Fire Alarm.—At the invitation of Sir Eyre Massey Shaw and the directors of the May-Oatway Fire Appliances, Limited, a large number of gentlemen, representing official and private bodies, including the War Office, the Admiralty, the City Corporation, Liverpool Overhead Railway, Mersey Docks and Harbour Board, electrical and railway companies, &c., &c., witnessed public tests of the company's system, which has been fitted in the Ilford Town Hall. The tests were carried out by a committee of the visitors, among whom were many representatives of fire brigades and fire insurance companies, and were in every case entirely satisfactory. The committee unanimously passed a resolution to this effect. Every room in the Town Hall has been equipped, the total cost being under £100; the alarm is given at the local fire station, and the position of the outbreak is shown on an indicator at the main entrance.

The Thames Valley Launch Company, Limited.—This company is arranging for two more electric charging stations, making, in all, eight stations belonging to it, where electric launches may be charged on the Thames. It is announced that a reduction in the price of current is to be made to the company's own customers, *i.e.*, those who have launches built by the firm, or who house their boats with them by the year. The price to them will be reduced to 8d. per unit, the usual charge on the river being 1s. 6d.

Trade Announcements.—The Britannia Electrical Works Company, of Tottenham, N., have been appointed sole agents for the United Kingdom for G. Wehr Söhne, of Berlin. The head offices and showrooms are at 43, St. Martin's Lane, Charing Cross, W.C., where all communications should be addressed.

Owing to the large increase in business, the Albion Clay Company have found it necessary to remove to larger offices at Members Mansions, 38, Victoria Street, Westminster, S.W. All communications should be sent to that address in future.

Messrs. Moores, Farrell & Co., of Manchester, have appointed Messrs. Alan Robson & Co., Imperial Buildings, Westgate Road, Newcastle-on-Tyne, to represent them in the Newcastle district as agents for the sale of their manufactured accessories and of Brockie-Pell arc lamps, also of the Consolidated Telephone Construction and Manufacturing Company's Telephones. Messrs. Moores, Farrell are sole agents for the North of England of both firms mentioned above.

Turbine Tube Cleaners.—Messrs. Babcock & Wilcox, Limited, manufacture a turbine tube cleaner which has been designed to facilitate the cleaning of boiler tubes, and to enable it to be done more economically and quickly than by hand cleaning. It consists of a turbine, operated by water power or air pressure, which works in ball bearings, and to which are attached four arms, having steel cutter-wheels at their extremities. Water power is mostly used for operating the tool; it may be obtained from the town water service, where this has sufficient pressure, or from a connection with the feed pump. River or sea water may be used for the purpose. A connection to the feed pump is generally adopted, as in this way the requisite pressure is most generally obtained. On board ship the donkey pump is best adapted. The water which operates and passes through the turbine has the beneficial effect of washing out the tubes. All parts of the machine are easily replaced. The cutting wheels, which are subject to most wear, are inexpensive. The water is applied through a strong hose pipe connected with a valve on a branch of the feed pipe, or direct with the feed pump. The turbine causes the cutter heads to revolve at about 2,000 revolutions per minute, thus cutting away the deposit. Messrs. Babcock & Wilcox have obtained the sole rights to sell the cleaner in all countries except the U.S.A.

ELECTRIC LIGHT AND POWER NOTES.

Alloa.—The street lighting installation with arc lamps was recently formally inaugurated, with great *éclat*. The installation consists of 20 public lamps, and a considerable amount of private lighting. Messrs. Buchan & Hogarth, of Edinburgh, are the engineers, and the energy is supplied by the British Electric Plant Company, Limited, whose works are approaching completion. Electric driving has been adopted throughout the latter.

Birkenhead.—An inquiry was held last week by Mr. M. K. North, representing the L.G.B., into an application made by the T.C. for power to borrow £40,000 for electric lighting purposes and other sums for local improvements. The town clerk explained that £11,270 was required to meet the cost of additional generating plant at the Bentinck Street works, and £5,800 for additional plant at the Rock Ferry works. £18,500 would be required for additional feeder and distributing mains, service mains, &c., and £2,000 for an extension of the arc lighting system. £2,430 was needed to cover an excess of expenditure over amounts already sanctioned. Mr. W. Bates, electrical engineer, stated that the Rock Ferry generating station was at present only used for traction. It was intended to add plant which would serve to supply current for lighting. The excess of expenditure over the amount previously sanctioned was occasioned by a sudden rise in the price of copper. There was no opposition.

Boston.—The T.C. has decided to invite public companies to tender for the installation of electric lighting and traction.

Bournemouth.—A leak in the electricity mains was discovered recently by the extraordinary behaviour of horses and dogs passing along the road over the spot. The quietest and most docile animals kicked and plunged, dogs howled, and the scene seems to have been very comical. It is a curious thing that the potential gradient on the surface of the ground should be so steep as to give shocks to horses, whose hoofs cannot be more than 4 ft. apart at most.

Chadderton.—The manager of the Lancashire Electric Power Company has sent the D.C. particulars as to the cost of street lighting, and, in accordance with his desires, a committee will hold an interview with him. The Board of Trade have granted the British Electric Traction Company, Limited, an extension of three months' time for carrying out the works authorised by the Middleton Light Railways Order, 1898.

Coventry.—The accounts of the electricity works for the quarter ended December 31st, 1901, at last show a surplus, after paying capital charges of £336, as compared with a loss of £280 in the corresponding quarter of 1900. The works cost was 1·64d. per unit, against 2·55d., and the coal used per unit 14·9 lbs., against 23 lbs. Also the price of coal has fallen immensely. Mr. Jeckell, the electrical engineer, is to be congratulated on these excellent results.

Cromer.—The U.D.C. has further considered the agreement for electric lighting with Messrs. Edmundson's Electricity Corporation, and has instructed Messrs. O'Gorman & Cozens-Hardy to prepare plans and specifications for the installation.

Datchet.—The P.C. has passed a resolution in favour of the introduction of electricity supply into the village by the Slough U.D.C.

Farnham.—The U.D.C., after two years' deliberation, has decided upon the introduction of electric lighting, and has instructed Sir Wm. Preece and Major Cardew to report on the proposals made by Edmundson's Electricity Corporation.

Glasgow.—The Corporation have agreed to extend the street lighting system by the addition of 228 arc lamps. The annual charge for these will be £14 per lamp. The estimated cost of erection will be £26 per lamp. All the streets included are traversed by electric trams, and it has been made an understanding that all tramway routes will receive first attention.

Gorton.—On the 14th inst. a special meeting of the E.L. Committee was called to discuss with Mr. Enright, consulting engineer, the offers received from the Manchester Corporation and the Lancashire Electrical Power Company to introduce electric light into the town.

Hamilton.—The T.C. is going to advertise for tenders to work the Council's prov. electric lighting order.

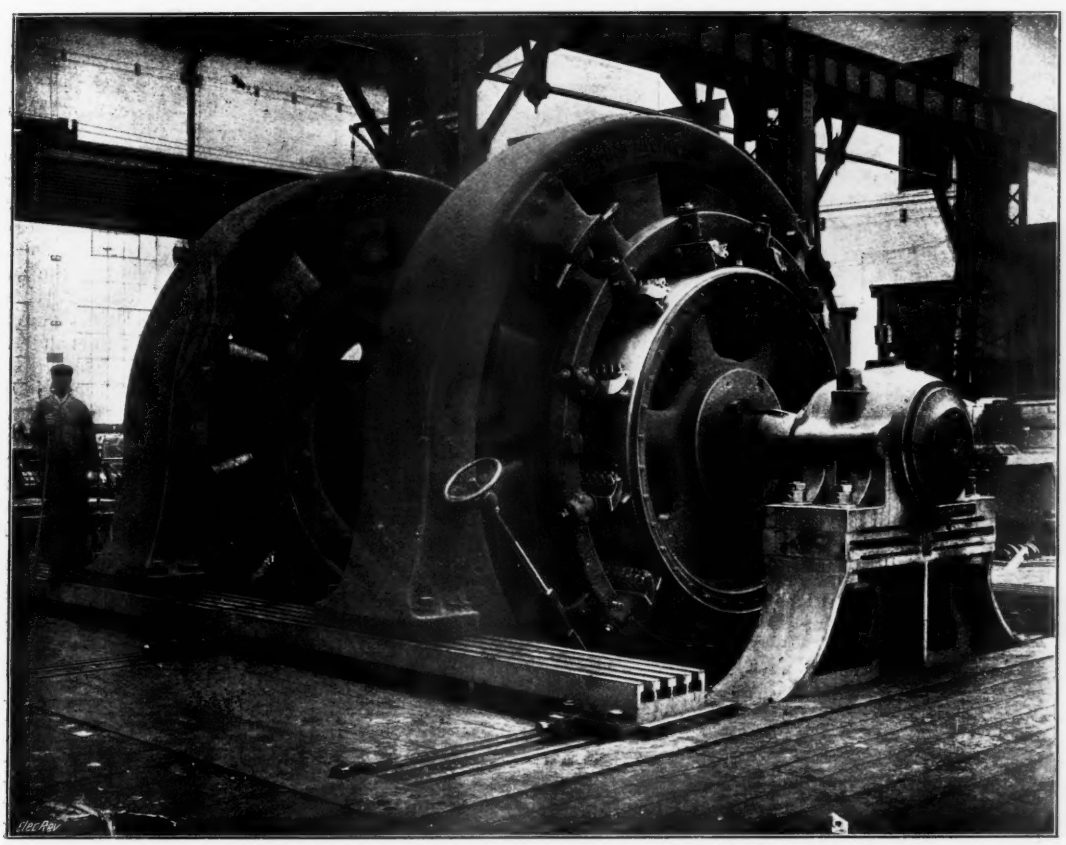
(*Continued on page* 144.)

LARGE GENERATORS FOR BOLTON.

On Thursday last week we had the pleasure of paying a visit to the English Electric Manufacturing Company's works at Preston, on the occasion of a full-load test of two 1,100-kw. machines, which are being supplied by Messrs. Dick, Kerr and Co., Limited, to the Corporation of Bolton, for lighting and traction purposes. These generators, which are among the largest direct current machines ever built in this country, are compound wound for 550 volts at full load, and will be arranged between the cylinders of "Musgrave" vertical engines, the armatures being coupled direct to the hubs of the fly-wheels. The speed of the combination is to be 100 revolutions per minute. The generators are 12-pole machines, and are in all respects in accordance with the standard practice of the English Electric Manufacturing Company. The magnet frame is made of cast-iron of a special quality, which has a high magnetic permeability ; the yoke is divided horizontally, so that the upper half of the frame can be removed for inspection purposes.

The two halves of the field magnet frame are held together by four bolts let into pockets on the inner surface of the castings, thus avoiding projections on the outer surface, which might spoil the symmetrical lines of the machines. The lower half of the frame has cast with it two massive supports, the lower surfaces of which are finished to a plane parallel with the armature shaft. By means of these supports the frame is held in a vertical position, with two rigid foundation girders having screws for adjusting the armature clearances horizontally, and a number of thin plates for vertical adjustment. The entire frame of the machine can be moved lengthwise over the engine shaft upon the foundation girders, thus uncovering the armature windings and permitting the removal of individual magnet coils without disturbing the upper half, so as to render repairs to the windings of either the armature or field coils easy and rapid.

The pole-pieces are of laminated steel, cast into the magnet frame with a cast-welded joint, which ensures a low reluctance in the magnetic circuit. The poles are provided with detachable shoes, which act as supports to the field magnet spools. The field coils are wound upon spools made of steel, with brass ends, one portion of the spool being occupied by the shunt winding, and the other portion carrying the series winding of copper ribbon. The shunt coils and the series coils are insulated from each other by a special combination of mica and paper, and both coils are insulated from the spool by a thickness of at least $\frac{1}{4}$ in. of the same insulation. The faces of the magnet cores and pole shoes are bored out after the cores are erected in position, thus ensuring the bore being exactly circular. The armature is built up on a spider of strong, tough iron, the sections of the rim being unconnected, in order to avoid shrinkage strains ; it is bored accurately to gauge, and is made slightly smaller than the diameter of the engine shaft, so that it requires a pressure of about 100 tons to force it into position. The core is built up on the ends of the arms of the spider, and consists of punchings made from high-class steel, which are thoroughly annealed and japanned.



Two 1,100-kw. Generators in Position for Test.

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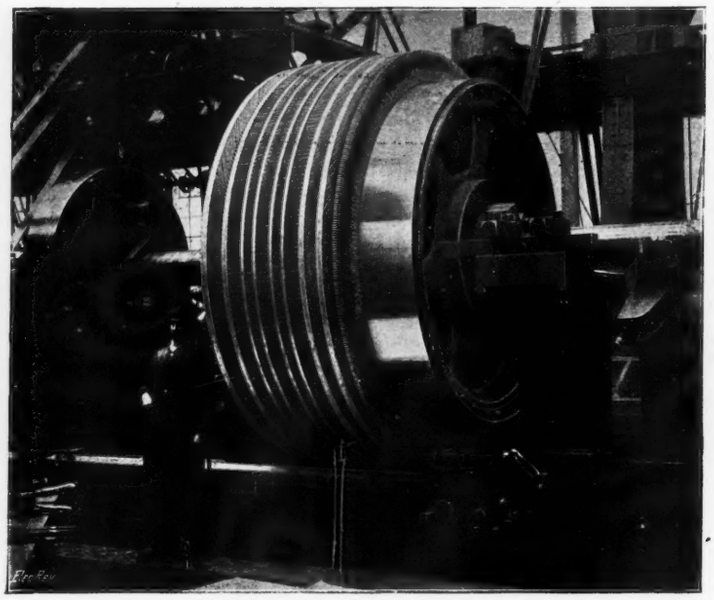
A special feature is the arrangement for giving effective internal ventilation to the armature. The segmental ends of the arms and the spider are so designed that air is admitted to the inner surface of the armature core and forced with great velocity through the radial ducts in the laminations, thus providing a most efficient system of ventilation for the core, armature coils and field magnets.



1,100-KW. ARMATURE IN LATHE.

The laminations of the armature core are securely clamped between two massive end rings, which are drawn together with a number of bolts passing through inside the core. The end ring farthest from the commutator is provided on its outer edge with a ventilated flange to support the ends of the armature coils, while the one next the commutator is provided with a number of clamps to secure the balancing rings, which are electrically connected at intervals with the commutator bars.

It is interesting to mention that balancing rings are provided on all direct current machines made by the English Electric Manufacturing Company, Limited, the effect of such rings being that any variation in the magnetic reluctance is nullified by them. Moreover, the use of these rings tends to prevent the motoring action of any given pair of poles which may occasionally arise in a multipolar machine. A further advantage gained is that it effectually balances the work of the armature, thus preventing one portion doing more than another.

The armature coils are laid in slots, the coils being former wound and thus made interchangeable. Very liberal provision is made for completely insulating the conductors from the core and from each other. The commutator is built up on a spider, very similar to that of the armature, with the exception of the rim being complete, which is carried on the hub of the armature. Steel end rings are provided, which clamp the commutator segments firmly to the periphery of the spider. The wearing depth of the commutator bars is never less than 1 in., and the length of surface insulation is usually $1\frac{1}{2}$ in. Carbon brushes are employed, and these are held in position by a special form of brush-holder carried on laminated copper strips having easy adjustments.

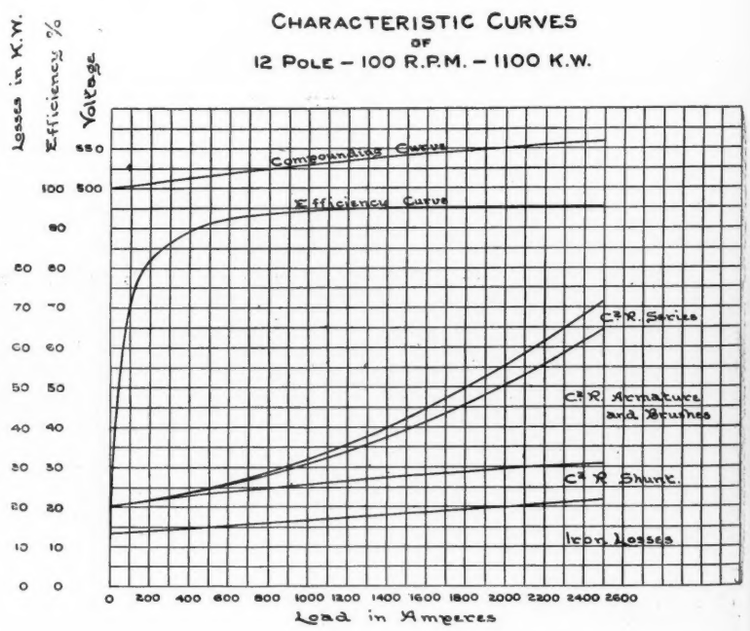
There are one or two special features about the arrangement of the brush-holders which do credit to the designer, Prof. Sidney Short, the technical adviser to the company.

The generators, at the time of our visit, were arranged on a testing bed, with their armatures mounted upon a common shaft and run on the well-known Hopkinson method, using one machine as a motor, driving the other as a generator, and making up the losses in the two machines from an external source. One of our views shows the combination on the test bed.

The machines are designed to deliver 1,100 KW. at 100 revolutions per minute, at a pressure of 550 volts. They were completed and erected on Wednesday afternoon, the 15th inst., when they were immediately put under a load of 2,900 amperes for one hour, or about 40 per cent. overload. On Thursday morning a thorough series of tests was made to determine the efficiency, various losses and compounding of the machines. The results obtained are shown by the accompanying curves.

On Thursday afternoon the machines were run under full load, and under loads of 3,200 amperes, or over 50 per cent. overload, and the load varied from nothing to 50 per cent. overload, without shifting the brushes, and without the slightest sign of sparking. Full load was thrown on and off without the least appearance of sparking at the commutators and without shifting the brushes.

On Friday morning, the machines were started under a load of 2,200 amperes, and allowed to run continuously under this load during the whole day, until the temperature, indicated by both the thermometers and the voltmeters across the fields, was found to be constant. The machines were then shut down, and the temperature of the various parts taken by the thermometer in the usual way. The results were as follows :—



Atmospheric temperature 58° F.

Motor armature	105° F. =	Rise 47° F.
„ commutator	96° F. =	„ 38° F.
„ field	110° F. =	„ 52° F.
Generator armature	103° F. =	„ 45° F.
„ commutator ...	95° F. =	„ 37° F.
„ field	116° F. =	„ 58° F.

The total weight of the machine equals 127,000 lbs. or 56 tons; that of the armature is 48,000 lbs. or 21 tons, and that of the fields is 79,000 lbs. or 35 tons.

Among other orders in hand, the following are at present passing through the shops:—London County Council, 15,000 KW.; Cape Town, 1,600 KW.; Perth (W. Australia), 550 KW.; Ilford, 1,200 KW.; Birkenhead, 500 KW.; St. Annes, 200 KW., &c., &c.

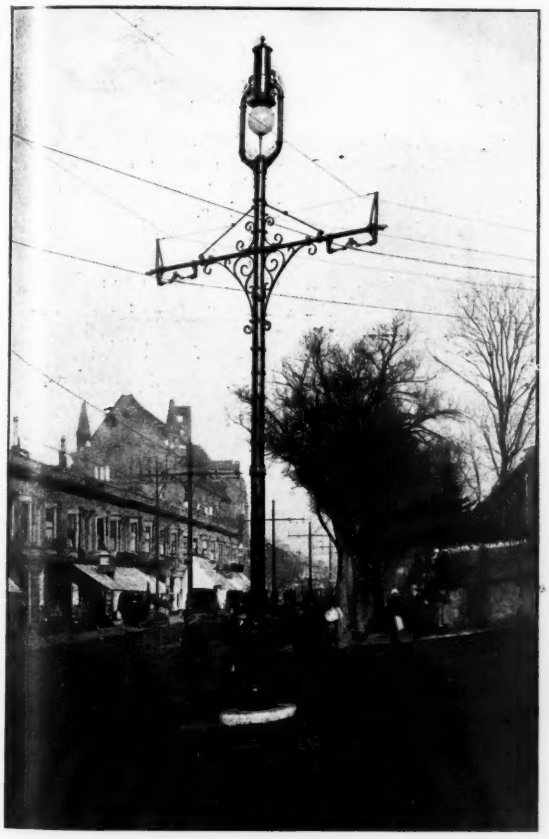
BRIGHTON CORPORATION ELECTRIC TRAMWAYS.

ATTEMPTS were made as long ago as 1897, by the B.E.T. Company, to introduce electric traction into Brighton, but were defeated by the Corporation. The latter, however, in 1899 decided to yield to the pressure of modern progress, and sought powers in the session of 1900 under a Bill for the construction of electric tramways; the Royal assent was given in August, 1900, and the Corporation at once took steps to carry out the work. Mr. Thomas B. Holliday was appointed as the Corporation tramways engineer and manager, and in the same month steps were taken to prepare the necessary drawings and specifications for the whole system. The various contracts were definitely settled and satisfactorily placed before the end of the year. The successful tenderers for the various works were as follows:—

Permanent Way.—Messrs. Macartney, McElroy & Co., Limited.
Overhead Construction.—Messrs. Robert W. Blackwell & Co., Limited.
Feeder and Distributing Cables.—The St. Helens Cable Company, Limited.

BRIGHTON.—THE OPENING DAY.

Engines and Dynamos.—Messrs. Bruce Peebles & Co., Limited.
Switchboard.—Messrs. Robert W. Blackwell & Co., Limited.
Rails, Fishplates and Sleepers. — Messrs. Bolckow, Vaughan and Co.

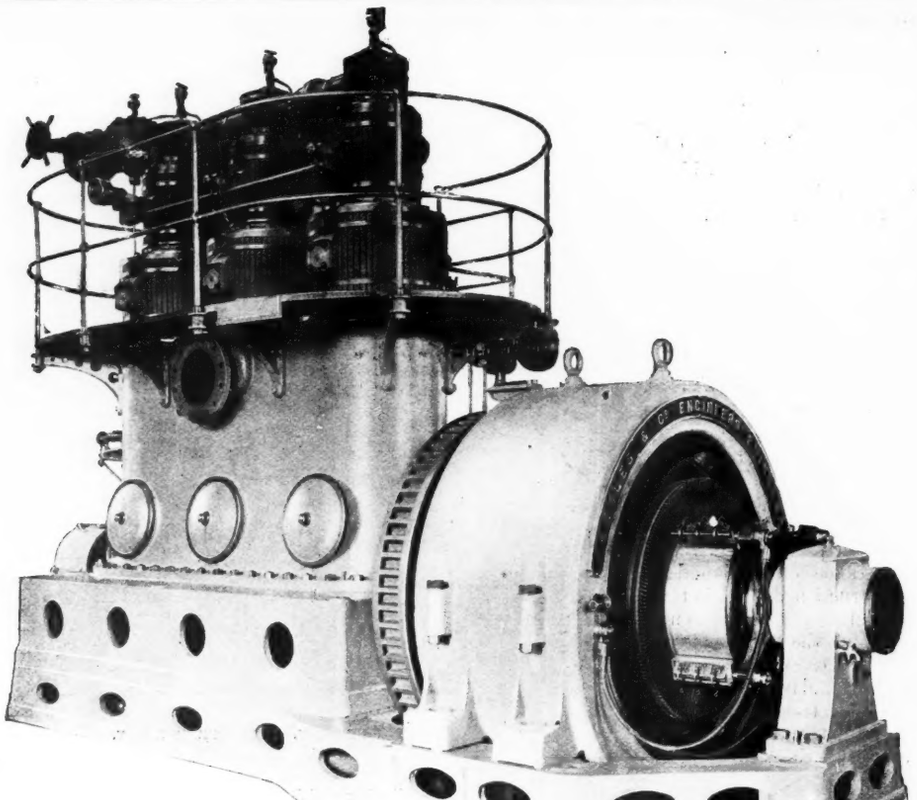


BRIGHTON.—CENTRE POLE AND LAMP.

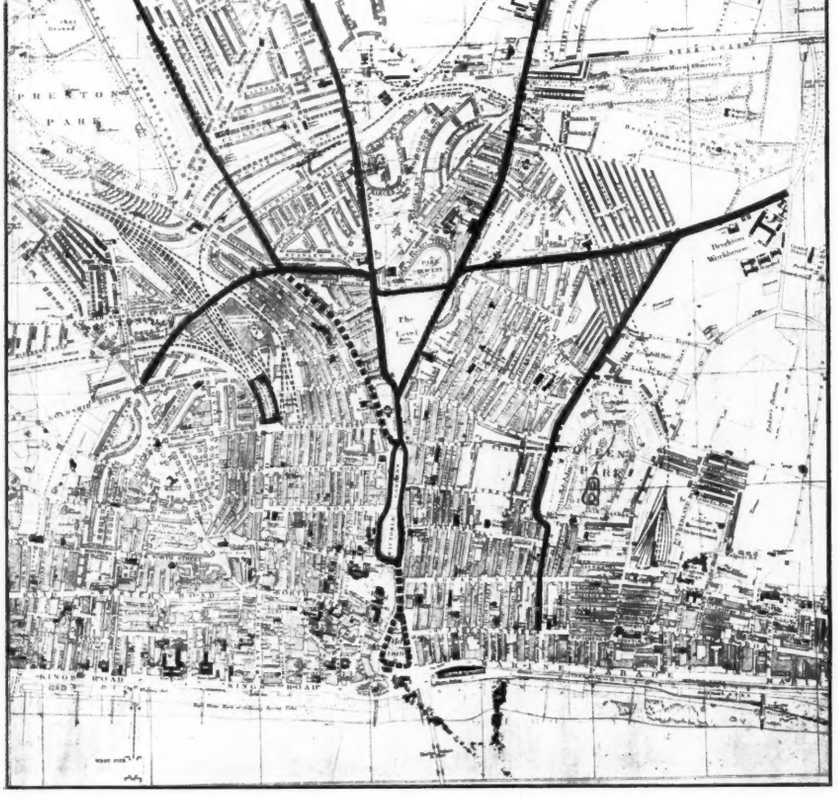
BRIGHTON.—SIDE POLE.

Points, Crossings, Tie Bars and Soleplates.—Messrs. Askham Bros. and Wilson.
Manhole Covers and Frames, and Gully Grates.—Messrs. G. Cash and Co.
Cars and Electrical Equipments.—The British Westinghouse Company, Limited.

The Corporation decided to erect the buildings themselves under the direction of their tramways engineer; the work of constructing the permanent way was commenced in



Brighton Corporation Tramways.—Peebles 325-kw. Generator and Willans Engine.



Brighton.—Map of Tramway Routes

February, 1901, and the whole of the other contracts and works were arranged to fall into line.

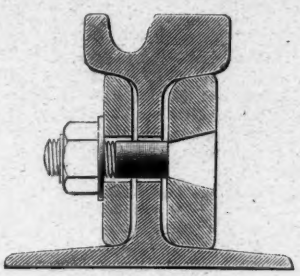
The concrete bed of the track is of Portland cement concrete, 6 to 1, and of the depth of 6 in.; the rails are of the girder type, 6 in. high with a 7 in. base, and weigh 101 lbs. per yard, the length of the rails being 36 ft., with a small proportion 30 ft. Extra strong fish-plates, weighing 46 lbs. per pair, were used, with 20-in. steel sole-plates under the rail joint, resting on a 6-in. steel girder sleeper running transversely to the rails. The method adopted for laying the permanent way was as follows:—The excavation being taken out to the necessary depth for the concrete bed, and also the trenches for the sleepers, the latter were then bedded on a 6-in. foundation of cement concrete; the rails were then laid in position and brought true to the required level and bolted up. Then the concrete bed for the permanent way was put in, the effect of this being to securely anchor down the rail joints with the full weight of the concrete substructure, and it is confidently anticipated that by this means the troublesome matter of loose rail joints has been effectually overcome. An even bed for

the reception of the wood paving was provided in fine concrete in the proportion of three parts sharp sand to one of Portland cement, wood paving being carried out throughout. The wood selected was American red gum blocks, which were dipped in hot pitch when laid, and then grouted up with hot pitch.

During the construction of this portion of the work a staff ranging between 400 and 600 men was employed.

The rail joints are double bonded with 0000 copper bonds of the Chicago Crown type. The steepest gradient on the system is 11 per cent.

The overhead construction was adopted, with side and



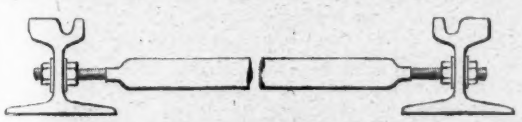
Section of Rail Joint.

centre poles. The poles are of drawn tubular steel, of the Mannesman Tube Company's manufacture, with bracket arms of 2½-in. steel tubing, and ornamental wrought-iron scroll work of elegant design, as shown in our views. The trolley wire is of 000 hard-drawn copper of high conductivity, the breaking stress being 6,000 lbs. Wood's frogs and crossings were used throughout. Proper provision has been made by guard wires for the protection of the telegraph and telephone wire which cross the track.

The car bodies are of the well-known make of Messrs. Geo. Milnes & Co., of Hadley, and are of the saloon window type, with reversed stairways, the inside finishings being of pollard oak and maple. Ample headroom has been provided, as well as excellent ventilation. The interior is lighted by eight electric lamps, and is provided with a full system of electric bells both for passengers and for the conductor and motorman. The outside panels are of a rich chocolate colour, with the borough arms on the centre panel. Destination boxes have also been provided, which are illuminated at night. The bodies are mounted on Peckham extra-long single trucks, with a 6-ft. wheel base, fitted with wheel brakes and double toggle track brakes. The Wilson Bennett life-guard was adopted, after a practical test with a dummy had been made by the tramways engineer. The electrical equipments are of the British Westinghouse type, with their 49 B motors, and series-parallel controllers with graduated electric brakes.

An annexe was built on to the Corporation electric lighting station for the accommodation of the generating plant.

The latter comprises three direct-coupled steam dynamos, consisting of Messrs. Bruce Peebles's dynamos and Messrs. Willans & Robinson's engines. There is one set having an output of 325 kw., and two smaller sets, each having an output of 175 kw. The engines are of Messrs. Willans and



Arrangement of Ties.

Robinson's patent central valve compound type, each having three cranks at 120° apart; each engine is designed to give 25 per cent. overload for half an hour at the specified speeds, the larger set running at a speed of 300 r.p.m., and, the smaller set at 350 r.p.m. The steam pressure is 175 lbs. per sq. in.

The dynamos are of Messrs. Bruce Peebles's multipolar compound-wound fly-wheel type, designed to give 500 volts at no load, and 600 volts at full load. The smaller dynamos are mounted direct upon an extension of the engine base plate, and the larger dynamo is mounted on an independent base plate.

The machines are designed so that the temperature rise does not exceed 70° F. after a six hours' full load run, and they are also required to be capable of withstanding a 25 per cent. overload for half an hour, and 50 per cent. momentary overload without damage or injury. The dynamo shells are of specially soft cast-steel and are of the split circular type, so that by removing the upper half the armature is readily accessible. Special terminal arrangements are provided, so that by removing the coupling links the connections of the two halves are immediately separated.

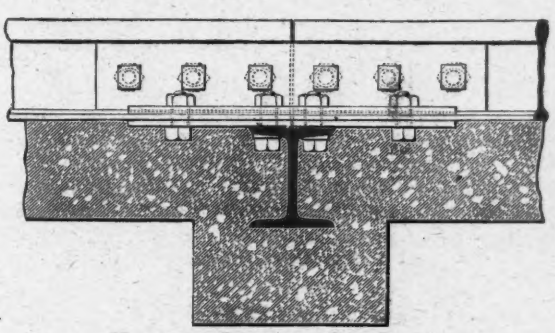
The magnet coils are wound on special cast-iron spools, which are made readily removable. The armatures are of Messrs. Bruce Peebles's well-known slot-wound type, built up on spiders of rigid design.

The commutators are also a special feature of these machines, and are designed in such a way that it is impossible for the bars to get out of place. The method of coupling is different from the usual form, being of the fly-wheel type, so that the strain is taken off the shaft, and the drive is at the periphery of the armature.

The machines run sparklessly under all conditions of load within their capacities without alteration in the position of the brushes, the latter being of carbon.

The illustration on p. 142 shows the appearance of the 325-kw. machine and engine.

Besides the steam dynamos mentioned above, Messrs. Bruce Peebles & Co. have supplied to the Brighton Corporation a motor-driven booster, which comprises two of their standard multipolar machines, coupled end to end and mounted on a combination base plate; the motor is a 40-h.p. 500-volt shunt-wound machine of the 4-pole completely protected type. The booster is a multipolar series wound



Method of Supporting Rail Joint.

machine, designed to give an output of 1,000 amperes at 25 volts, or 100 at 10 volts, with the intermediate currents at corresponding voltages. These machines are generally similar to the generators; switch gear is provided, consisting of a starter for the motor and a shunt switch and resistance for the series fields of the booster, by means of which any required variation can be obtained. The speed of the combination is 800 revolutions per minute. These machines, like the larger generators, are designed so that the temperature rise shall not exceed 70° F. on a 16 hours' full load run, and are also capable of withstanding an overload up to 25 per cent.

The boilers are the Babcock & Wilcox type. The switchboard consists of eight panels of polished white marble, comprising three machine, three feeder, one booster, and one Board of Trade panels.

A suitable site was selected in the Lewes Road, on which has been erected a handsome and commodious car shed, constructed of brick with iron roof, well lighted, to house 36 cars, and examination pits have been provided under each track, so that the moment a car comes to rest, it is in a position ready for overhauling. The pits have been lined with white glazed bricks, in order that an efficient light may be obtained by bringing the walls into use as reflectors; they also enable the work pits to be maintained in a thoroughly clean and sanitary condition. The headroom provided under the roof principals is 19 ft. Ample workshops have also been built in connection with the sheds, comprising a fitter's shop, woodworking shop, armature-winding room and paint-shop, and machinery of the most approved type

has been selected, and the whole of the repairs will be effected on the premises. A sand dryer has also been provided.

A handsome suite of offices have been built on the frontage to Lewes Road, a portion being two stories in height. The ground floor is for the traffic department and stores, and the upper floor for drawing offices, &c., in connection with the engineering department.

Six and a half route miles have been constructed, or 11½ miles of tramway as single line.

There are five routes, as shown on the map, viz.: Lewes Road, New England Road, Elm Grove, Queen's Park Road, Beaconsfield Road, and Ditchling Road, the latter being worked as a circular route.

Lewes Road will have a 5-minutes service of cars, and the other routes a 7½-minutes service, but the Beaconsfield Road and Ditchling Road routes being worked as a circular route, will, in effect, give a 3¾-minute service at the extreme ends, as it is possible to reach the same point by travelling in either direction. Thirty cars have been provided for the service. The terminus or starting point, common to all routes, will be in Church Street, at the northern end of the Royal Pavilion Gardens.

Further powers are being sought in the ensuing session for extensions, and the terminus will then be made at the southern end of the Old Steine enclosures, and in close proximity to the New Palace Pier and Winter Gardens. A further extension is to be carried along the London Road; this will connect the existing lines between the junction at New England Road and the southern end of St. Peters' Church, enabling the cars on the New England Road, the Beaconsfield Road and the Ditchling Road lines to be operated on the more direct route along the London Road to the sea front.

The engineer and manager, Mr. T. B. Holliday, has acquired a large and varied tramway experience, extending over a period of 20 years, and embracing horse, cable, and electric traction in Melbourne, Australia, Bristol, Dublin, Stockton and Middlesbrough, and London; Mr. Holliday also acted as consulting engineer to the promoting syndicate of the Perth Electric Tramway, Western Australia. We are indebted to him for the particulars regarding the tramways, and the photographs, which we have embodied in the foregoing article.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 138.)

Heston-Isleworth. — The U.D.C. has decided to appoint an expert upon proposals to light the district by electricity, with a view to carry out the Council's order, recently acquired.

Huddersfield.—An inquiry was held last week by Mr. M. K. North, inspector under the L.G.B., into an application of the T.C. for leave to borrow £100,000 for extensions of the electricity works. The borough electrical engineer (Mr. A. B. Mountain), stated that it was intended to provide a reserve storage for 2,500 tons of coal. Since the works were established there had been an average annual progress of 15,000 lights.

Hull.—Last week Colonel A. J. Hepper, R.E., held a L.G.B. inquiry into the application of the T.C. for leave to borrow £47,900 for electric lighting purposes. The present debt of the city amounts to over £2,000,000. Mr. A. S. Barnard, city electrical engineer, explained that the present loan was wanted for extensions of the works and mains; provision was to be made for plant of 5,000 H.P. capacity, of which one-third would be put down at first.

Liverpool.—The special committee which has had to revise the estimates of expenditure in the principal spending departments of the Liverpool Corporation, has approved of the sum of £49,149 as the estimate for electric power and lighting for the ensuing year.

London.—LEWISHAM.—The B.C. has agreed to the proposal of the Camberwell B.C. to apply for a provisional order to supply electricity in the parts of Lewisham which were tranferred to the Borough of Camberwell by the Local Government Act, 1899.

The Metropolitan Asylums Board finds that the total cost of the electric light installation at the Northern Hospital has amounted to £11,781.

Manchester.—The foundation stone of the Stuart Street electricity works was formally laid on 16th inst. The buildings will cover about 8 acres, and will eventually comprise about 72,000 H.P., making the station probably the largest in Europe. The estimated cost of the instalment of 27,000 H.P. now in hand is nearly £1,000,000. It is anticipated that the first of the generating sets will be at work by the end of April.

Mansfield.—The T.C. has decided not to oppose the Derbyshire and Notts Electric Power Bill.

Monmouth.—A suggestion has recently been made in the T.C. for either transferring the electric lighting works to a private company or raising a loan on mortgage of plant. The matter has been deferred.

Newcastle-on-Tyne.—An important scheme is being carried out in regard to the electric lighting of the main streets of Newcastle-on-Tyne. In 1900 a report was presented to the City Council by the Watch Committee, in which it was suggested that £10,000 be obtained on loan, and certain of the main streets be lighted with electricity. The idea, which is now being put into practice, was to utilise the tramway poles to carry the lamps. It was estimated that to light all the streets in which tramways would be laid, would require 373 lamps, at a total annual cost of £6,714, as against £2,541 for the cost of gas. The Committee limited its recommendation to 180 lamps, at an annual cost of £3,240 (estimated), as against £1,514 for gas and some 18 arc lamps at present in the main streets. While the cost will be doubled, the amount of light which the new lamps will give, will be increased four-fold. Since the Committee made its recommendation, it has been decided to put up 200 arc lamps at £18 per lamp. The lamps will be fixed on the poles, about 40 yards apart. The power will be obtained from the Corporation's power station, but the lamps will be fed by separate mains from those utilised for the trams, and will be on the alternative system, so that in case of accident only half the lights would go off, and if it were desired to reduce the light half could be cut off.

Partick.—The new destructor will be officially opened on or about February 1st. The street lights will, however, be switched on before that date as soon as the station is complete.

Prison Lighting.—Mr. R. F. Yorke, writing to a Glasgow evening paper, draws attention to the fact that the prison at Fort William has been lighted with electricity for several years, so that York Prison is not the first to be so lighted.

Salford.—A L.G.B. inquiry was held last week by Mr. M. K. North into the application of the Corporation for leave to borrow £5,000 for the purchase of motors to let on hire, and £25,000 for electric lighting purposes. The motors were to have an average of 5 H.P., ranging from ½ H.P. to 25 H.P., and numbering 100. Mr. C. D. Taite, borough electrical engineer, explained the details of the scheme. There was no opposition.

South Shields.—A series of violent explosions in manholes took place recently, many windows of adjoining houses being broken.

South Wales.—The S.W. Electrical Power Distribution Company has given the contract for the erection of the first power station, at Treforest, to Messrs. Holloway Bros., of London. The designs provide for an installation of 15,000 H.P. in the first instance, to be eventually increased to 70,000 H.P. In the meantime a temporary plant will be put down. Work is also in progress at Neath.

Wimbledon.—Mr. F. H. Tulloch, M.I.C.E., will hold a Local Government Board inquiry to-day (Friday), as to the U.D.C.'s application to borrow £18,500 for electric light extensions.

ELECTRIC TRACTION NOTES.

Aberdeen.—A report by the burgh surveyor and electrical engineer in connection with the electrical equipment of the Rosemount circular route has been before the Tramways Committee. The combined estimates amount to £11,000 to £12,000. The electrical engineer proposes to place poles with long arm brackets along the west side of Union Terrace, thereby obviating the necessity of having poles on the east side of the terrace, next the gardens.

Belfast.—For the past year the Belfast Tramway Company has been the best abused company in the correspondence columns of the local papers, for alleged inefficiency in its service and cruelty to the horses. That both service and horses could be bettered is undeniable, but the company is in possession till 1907, and for three or four years the first city in Ireland will have to bear with things as they are, unless the Corporation nerves itself to buy up the interest of the company and substitute electric traction.

Birkdale.—The tender for the Birkdale electric power station has been let to Messrs. Duxfield Bros., of Southport, at £3,416. The building is to be ready for the installation of machinery by the end of March, and it is anticipated that the current will be available for the York and Anghton Road sections, and that the cars will be running in June. The contract for the overhead equipment has also been let.

Brighton.—Colonel Von Donop, the inspector appointed by the Board of Trade, paid another visit to Brighton on 14th inst. to satisfy himself as to the working over the hilly routes of the brake fitted to the cars to prevent them from running back. Colonel

Von Donop expressed his intention of at once passing the routes which have not hitherto been available for the public service, so that the Tramways Committee now only await the receipt of the formal certificate from the Board of Trade before bringing the full service into operation.

Canterbury.—The Canterbury and Herne Bay Light Railway promoters have asked the Council to waive their stipulation that wherever the trams run the streets must be widened to 21 ft., and also not to enforce the demand that wood paving should be put down. The Council, however, adheres to its decision.

Chatham.—The cars for the Chatham and District Light Railways Company, which have been built by Messrs. Milnes, have been received.

An order has been made by the Board of Trade, under the Military Tramways Act, 1887, authorising one of his Majesty's Principal Secretaries of State to construct and maintain a tramway at Gillingham (Chatham), running from the Royal Engineers' Park to Darland Hill.

Chester.—Last week the T.C. resolved that the conversion of the remainder of the tramways not at present worked by electric traction be included in the authority obtained by the Committee, so that the whole might be put in hand at the same time, the overhead trolley system being adopted throughout. The cost of the section to Saltney was stated as £34,000, and of the remaining length to the station £23,000.

City and South London Railway.—On 16th inst. a mishap occurred on this railway. The official statement made to the Press by Mr. Jenkins, the general manager of the line, showed that a down train which was running between the Elephant and Castle and the Borough stations at 7.30 a.m., was within 200 yards of the latter station, when a short circuit occurred in the motor of the locomotive. This resulted in a breakdown of the engine, and the train came to a standstill. Assistance was sent for, and another train which was coming up behind the one which was disabled, pushed the first train into the Borough station. The passengers alighted in the station, but were somewhat disquieted at the presence of a considerable volume of smoke, which had proceeded from the locomotive, owing to the ignition of the insulation. On examination, it was found that the accident to the mechanism was of a serious character, and it was decided that the current should be completely switched off from the line for a short period. This was done from the generating depôt in Clapham Park Road. The traffic was dislocated for about an hour.

Dublin.—The scheme for the connection of Enniskerry and Dublin by the Dublin and Enniskerry electric tramway has been vetoed by the Irish Privy Council on the grounds that the places mentioned are already connected by railway. Of course, the promoters of the tramway can proceed by a special Bill in the Commons. The proposed line would open up and develop a fine residential district.

Dudley and Blackheath.—Recently an excellent scheme was prepared by the Dudley and Rowley Regis authorities for the construction of an electrically-equipped tramway from Dudley to Rowley and Blackheath. It has now, however, been abandoned, the two authorities being unable to agree.

East London Railway.—At the meeting of the East London Railway Company on Monday, the chairman said that the question of electrifying their line was being considered by the committee of managers to whom it had been referred. Their report would be presented at the next meeting; but meanwhile he understood that they favoured the employment of both the steam and electric systems. They would have to remember that the Brighton, South-Eastern, and Great Eastern systems, which ran over their line, still employed steam. So that for that section of their traffic the East London Company would have to adopt whatever system was best for linking up with the three lines named.

Failsworth.—The D.C. has been informed by the Manchester Corporation Tramways Department, that the reconstruction of the Failsworth tramways would be proceeded with in the spring or summer of this year, but, inasmuch as the Electricity Committee were unable to supply current for the working thereof until March 31st, 1903, the Tramways Committee had entered into an arrangement with the Manchester Carriage and Tramways Company to continue working the same by horse cars until the expiration of that time.

Farnworth.—The B. of T. inspection of a portion of the new lines and equipments was made on the 9th inst. There are eight bogie cars supplied by the Westinghouse Company, and they have Blackwell's patent trolleys. Four of them have Tidswell's automatic life guards. The cables were put down by the B.I.W. Co.; the poles were supplied by Messrs. Russell, of Wednesbury. Mr. J. D. Pember is the electrical engineer and tramways manager to the U.D.C.

Greenock and Port Glasgow.—The Corporation in view of their deciding, at some future date, to purchase the tramway undertaking, have decided to oppose the company's new Bill for extensions and powers to run omnibuses at tramway termini.

Heston - Isleworth.—The General Purposes Committee of the U.D.C., having inspected the plans of the London United Tramways Light Railway Extensions (No. 2), and of the Hounslow, Slough, and Datchet Light Railway, recommended the Council to oppose both schemes. This was agreed to at the last meeting. By mutual arrangement, Mr. Bousfield has been appointed to value property affected by the authorised lines.

Houghton-le-Spring.—The United Kingdom Light Railway and Tramway Company has intimated to the District Council its intention of applying to the Board of Trade for a further extension of time for the commencement and completion of the Houghton-le-Spring and district tramway scheme. The Council will follow the examples set by the other Councils, and lodge an objection.

Huddersfield.—From a financial statement prepared by the borough treasurer, it appears that the receipts of the steam section for the nine months ending December 31st last amounted to £16,844, or 13·75d. per car-mile. The expenditure for the same period was £19,531, or 15·95d. per car-mile, or a loss of 2·20d. per car-mile. Upon the electric section for the nine months the receipts amounted to £21,307, or 11·04d. per car-mile. The expenditure amounted to £23,968, or 12·41d. per car-mile, showing a loss of 1·37d. per car-mile. The totals included (in the steam section)—depreciation £2,263, and interest and sinking fund £3,953. In the electric section the sums respectively were £3,987 and £8,586. The total loss on both sections is thus £5,347 for the nine months.

The Tramways Committee have decided to experiment with cast-iron blocks for paving two miles of the tramway lines.

Italy.—The Allgemeine Electricitäts Gesellschaft, of Berlin, is in negotiation with the Italian Government with regard to the concession for the building of the projected direct electric railway between Rome and Naples.

Liverpool.—When a massive iron beam about 30 ft. long was being raised by a derrick at the new buildings of the Royal Insurance Company, at the corner of North John Street and Dale Street, it slipped from the chain and fell, 50 ft., to the street, cutting the electric trolley wire on the "inwards" track and straining one of the standards. The ends of the broken trolley wire fell to the ground and sparked freely. Traffic on the "inwards" line was stopped until the trolley wire, of which about 100 yards had fallen, was renewed. The beam fell across the street within 6 ft. of the rear of a car going towards the Pier Head. No personal injury was, however, caused.

At a meeting of the Liverpool Engineering Society last week, Mr. F. B. Behr, Assso.Inst.C.E., delivered an address on "High Speed Electrical Railways and the Proposed Mono-rail between Manchester and Liverpool."

Merton.—The Parish Council has decided unanimously to oppose the L.U.T. proposals affecting Merton, especially with regard to a portion of the scheme involving a single line on a very narrow thoroughfare. Part of the route is along a country lane, which the company promise to widen to 40 ft.

Potteries.—Upon the invitation of the Fenton U.D.C., a conference of representatives of the local authorities of the Potteries district was held at Fenton last week to consider the new Bill which is being promoted by the Potteries Electric Traction Company. The Bill was referred to a Committee, consisting of the clerks to the various local authorities, to consider and report.

Rothesay.—The T.C. have decided to oppose the tramway company's Bill, as not agreeing with Standing Orders, and also on the point of the proposed method of erecting overhead work in certain streets.

Sandgate.—At the last D.C. meeting drafts of agreement between the Council and Hythe and Sandgate Electric Company, appertaining to tramways and electric lighting, and the Folkestone Electricity Company, were received and fully discussed, and referred to the clerk.

Sutton.—The provisional agreement between the U.D.C. and the tramways company provides *inter alia* that the company shall pay £2,000 cash on commencing the line, to be expended by the Council on street improvements. To satisfy the residents of Belmont, the company undertake not to take a line along Brighton Road without the special consent of the Council.

Swindon.—With reference to the tramway scheme, Alderman Wright suggested that before overhead traction was definitely adopted a committee should visit Wolverhampton and see the system in use there. Mr. Ernest Carpenter, chairman of the Electric Committee, argued that the overhead system had been adopted after most careful consideration and consultation with Messrs. Lacey & Clirehugh, electrical engineers, and he did not think the Corporation would care to throw away money on a purely experimental system, while the overhead system had proved efficient all over the country. The suggestion to visit Wolverhampton was rejected.

Wallington.—Last week at a crowded and excited meeting of ratepayers it was decided to ask the R.D.C. to oppose the tramway proposals of the B.E.T. Co. At the end a poll was demanded, and the result of this has been to confirm the resolution by a majority of 282 votes against 275.

Whitworth.—Mr. J. S. Enright is to report to the U.D.C. on electric trams.

Wimbledon.—The U.D.C. have at length arrived at a decision on the tramway question, and have adopted a report of 12

pages of printed matter, approving of the proposals of the L.U.T., except in the following particulars:—

1. Wonple Road line to be double track, and Hill Road to be widened to 50 ft. near the railway bridge.
2. The offer of the company to pay £30,000 towards the cost of widenings is rejected, and the company is asked to pay the whole amount (except No. 4).
3. The line up the Hill to the Common not to be constructed without special consent.
4. The company to pay £5,000 towards the cost of widening High Street and Church Road, the money to be paid on commencing to lay the lines; but the Council to proceed with the widening in their own manner.
5. Statutory widths for Merton High Street.
6. Footways to be 9 ft. wide (except by consent).
7. Annual rental £100 per mile.
8. Wood paving throughout, or as approved by the Council.
9. Protective clauses for sewers, the Council's own lighting cables, cheap fares, return tickets, no advertisements on cars, approval of construction, &c., including payment of Council's costs.

The Council also decided to obtain protective clauses in the Bill for the Wimbledon "Tube," and with regard to the Metropolitan Railway's proposed generating station in the district.

Wolverhampton.—The Tramways Committee and the Corporation are now inviting tenders for the construction of a new tramway track from Snowhill along Dudley Road to the borough boundary at the Fighting Cocks. The length of the route is just over 1 mile, and it will, when completed, connect Wolverhampton with Sedgley and Dudley. It is hoped to finish it before the opening of the approaching exhibition. Mr. Holloway is now making rapid progress with his contract. The line on the Bilston Road to the borough boundary is now practically complete, and connections are being formed at Piper's Row and Lichfield Street, in the centre of the borough. When these are finished and a short length of line has been laid from Queen Square to Waterloo Road, and the Lorain circuit boxes laid, then there will be a connection from Tettenhall, *viâ* Newhampton Road, to the borough boundary at Bilston. This section, it is hoped, will be in complete working order for the Exhibition. It is not intended to interfere just yet with the old Tettenhall Road route, the intention being to keep this line with the present system of horse cars in reserve until the alternative line is electrically equipped and working.

TELEGRAPH AND TELEPHONE NOTES.

Dover Telephones.—The Corporation has decided not to apply for a municipal telephone licence. This decision will affect the proposal of the Folkestone Corporation to introduce a municipal system, as Folkestone is within the same area.

Dundee Telephones.—It is stated that about 7,000 circulars were issued regarding the proposal to establish a municipal telephone system in the city, and already more than 1,000 replies have been received. The desire to be connected with such a system is said to be pretty general among these.

Durban Telephones.—The Town Council recently decided to take over the local telephone system as from January 1st, the company having agreed to waive the three months' notice. The necessity for haste in the matter was in view of the early inauguration of the electric tramways, as the company's wires were in the way in many places and the Corporation could not compel their removal.

German Cable Schemes.—A Dutch German company has been formed for extending the New York—Manila telegraph cable to the Celebes and the German South Sea Islands.

Huddersfield Telephones. — The General Purposes Committee has deferred the question of municipal telephones for a period of three months.

At the last Council meeting, Mr. T. H. Moore (chairman of the Tramways Committee) urged that as many streets would be disturbed during the electrification of the remaining steam tramway routes, a deputation should be appointed to ascertain on what terms the Telephone Company would agree to the construction of underground wires, and to arrange, if possible, for such work being carried out concurrently with the operations of the Tramways Department. He moved to this effect, and his motion was adopted.

Manchester Telephones. — The Withington U.D.C. dissents from the application to Parliament of the National Telephone Company, for an Act conferring certain powers on the company within the Manchester Telephone Exchange area.

Portsmouth Telephones.—No time is to be lost in setting up the Municipal Telephone Exchange, for which a loan of £26,000 has been sanctioned by the Local Government Board. The Telephone Committee of the Town Council has decided to recommend that Mr. Gardner, of the Tunbridge Wells Municipal Exchange, be engaged as engineer and manager.

The Telephone Service.—As a result of the dissatisfaction with the telephone agreement between the Postmaster-General and the National Telephone Company, it had been arranged that the Lord Mayor, Sir Joseph Dimsdale, should move the following amendment to the address in the House of Commons:—

And we humbly represent to your Majesty that it is essential that a complete inquiry should be made into the working and practical effect of the licences and agreements now being acted upon by the Treasury, the Post Office, and the National Telephone Company; and the desirability of suspending any further transactions between those departments and the company in reference thereto until such inquiry has been completed, and its results considered by your Majesty's Government.

It was, however, announced in Wednesday's *Times* that "the Government have promised certain concessions to Sir Joseph Dimsdale on the telephone question. Hence his amendment to the address will not be moved."

The matter is further dealt with in Thursday's *Times* in the following terms:—

"Although Sir Joseph Dimsdale, in consequence of assurances which he is understood to have received from the Government, has decided not to move his amendment to the Address urging the desirability of suspending negotiations between the Treasury, the Post Office, and the National Telephone Company, pending a complete inquiry in the working and practical effect of the present licences and agreements, the London Liberal members do not intend to let the matter drop until they have been told precisely what course Ministers intend to pursue. Mr. Lough has given notice of an amendment in terms identical with that formulated by the Lord Mayor of London, his desire being to elicit from the Government a definite promise that a committee shall be appointed."

It is stated in the *Daily Telegraph* that no real basis of negotiations can for the present be arrived at, and Sir Joseph Dimsdale intends to move his amendment on Monday.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus	.. June 20, 1899 ..	..
Para-Maranham	.. March 1, 1900 ..	..
Mole St. Nicholas-Port au Prince	.. Dec. 28, 1901 ..	..
Coro-Maracaibo (Venez.)	.. Jan. 8, 1902 ..	Jan. 16.
Alexandria-Larnaca	.. Jan. 19, 1902 ..	..
LANDLINES:—		
"*Via* Hanekin" on Persian territory ..	.. Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
Cap Haitien-Port au Prince	.. Jan. 14, 1902 ..	Jan. 17.
Cap Haitien-Port au Prince	.. Jan. 22, 1902 ..	..

Underground Wires v. Submarine Cables. — Sir John Leng recently made a suggestion for an East Coast submarine cable, to prevent a repetition of the recent serious interruptions of telegraphic communication with the large commercial centres on the East Coast.

Lord Londonderry, in his observations on the point, said:—

The underground line to the north which is now being laid will extend, in the first instance, to Birmingham, Liverpool, Manchester, Leeds, Newcastle, Glasgow, and Edinburgh, and will afford security against interruption of telegraphic communication, not only to those important cities, but also to many intermediate towns, while it will give practical security to Sheffield and the towns on the east coast, and increase the stability of the telegraph service generally. To carry out your plan with any approach to efficiency it would be necessary to lay one four-wire cable from a point near Harwich to a point near Hull, one four-wire cable from a point near Harwich to a point near Newcastle, three four-wire cables from a point near Harwich to a point near Leith, one four-wire cable from a point near Harwich to a point near Dundee, and continue the same cable to a point near Aberdeen. These cables, together with the necessary connecting wires to the Central Telegraph Office and the post offices at Hull, Newcastle, Edinburgh, Dundee, and Aberdeen, would cost 50 per cent. more than the underground line to the north which this department is laying down; and it would afford no security to Birmingham, Manchester, Liverpool, Leeds, or Glasgow. The underground line is now approaching Stafford, and will be extended as soon as possible to Warrington, whence there are underground wires already to Liverpool and Manchester; and the scheme will be so carried out as to fit in throughout with the overground system, and be available for making good interrupted aerial wires at a good many points. The submarine cables, on the other hand, would be out of relation with the overground system, and could not be connected or fitted in from time to time at intermediate points. . . . .

No satisfactory type of paper-insulated cable for submarine use has yet been produced. It is still necessary, in submarine cables, to use gutta-percha. Therefore, if we resorted to submarine cables, we should lose the advantage in electrical efficiency which we have gained in our underground line by the adoption of paper-insulated wires. There are other respects in which the submarine cables would compare unfavourably with the underground line. They would be more costly to maintain; they would be often, and for considerable periods, interrupted; they would increase the difficulty and cost of maintaining the existing Anglo-Continental cables, across which they would be laid; and they would require to be entirely renewed much sooner than the underground line. But the main objections are that they would cost more to construct, would be less efficient from an electrical point of view, and would afford less security to the telegraphic communications of the kingdom.

Wireless Telegraphy.—In the House of Commons on Monday, Mr. J. Dewar asked the Secretary to the Treasury, as representing the Postmaster-General, if he would consider the expediency of adopting the Marconi system of wireless telegraphy as a means of communication between the Outer Hebrides and the western mainland of Scotland.

Mr. A. Chamberlain, in reply, said that for the present the existing telegraph cable to Stornoway affords adequate means of telegraphic communication with the Outer Hebrides.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 12th. Tramway poles, bases and trimmings for Corporation. See "Official Notices" to-day.

Barking Town.—January 24th. Additional generating plant for the Council's electricity works. See "Official Notices" December 20th.

Belgium.—February 15th. Proposals are being invited by the municipal authorities of Lourain for the lighting of the public streets by electricity or gas.

Belgium.—March 1st. The municipal authorities of Ghent are inviting tenders until the March 1st, 1902, for the concession for an electric lighting installation. See our "Official Notices" January 3rd.

Birkenhead.—February 11th. Feeder mains, pilot wires, and distributing mains for Rock Ferry and district for the Corporation. See "Official Notices" to-day.

Blackburn.—January 27th. Engineering stores for the electricity and tramway departments for one year; also oils and greases for ditto. See "Official Notices" January 17th.

Croydon.—February 17th. 10 double-deck double-truck cars with motors, &c., for Corporation. See "Official Notices" to-day.

Fulham.—January 27th. Twenty 50-KW. transformers, mains, conduits, lamp-posts and street boxes. See "Official Notices" January 10th.

Hartlepool.—January 25th. Buildings, marine boilers, engines and dynamos, battery, switchboard, arc lamps, columns, mains, and cranes, for electricity supply works for the Corporation. See "Official Notices" January 3rd.

Ilford.—January 27th. Rail-bonds, conduits, draw-boxes, &c., for the U.D.C. tramways. See "Official Notices" January 10th.

L.C.C.—January 28th. The L.C.C. is in the market for about 3,250 tons of track rails; 1,850 tons of slot rails; 670 tons of conductor tee rails; fishplates, bolts, nuts, &c., required in connection with the reconstruction of tramways for electric traction. Specifications, &c., at the County Hall, Spring Gardens, S.W., upon payment of £2.

Leyton.—February 13th. Steam and other piping for U.D.C. electricity works. See "Official Notices" to-day.

London.—March 4th. The L.C.C. is wanting tenders for 100 or 50 double-deck double-bogie tramcars for conduit lines in South London. Drawings, &c., at the County Hall, Spring Gardens, S.W. (£3).

Lytham.—January 31st. The U.D.C. invites tenders for the erection of engine and destructor houses, and cottage; and for two centrifugal pumping engines, steam dynamo, electric light fittings and travelling crane. Specifications, &c., of the engineer to the Council, Mr. A. J. Price, U.D.C. Offices, Lytham.

Manchester.—January 28th. Coal and ash elevating and conveying plant for the Stuart Street generating station of the Corporation. See "Official Notices" January 17th.

Manchester.—February 13th. Condensing plant, cooling towers and feed water heaters for the Corporation. See "Official Notices" to-day.

Rochdale.—February 2nd. Lighting switchboard extensions for the Corporation. See "Official Notices" January 17th.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See ELECTRICAL REVIEW, January 10th.

Salford. — February 8th. Two 150-KW. continuous current motors for the electricity works. See "Official Notices" to-day.

Shipley.—The D.C. is inviting tenders for the construction and reconstruction of about 1½ miles of double line.

Shipley.—February 10th. Traction switchboard, boosters and balancers, switchboard alterations, for the Council. See "Official Notices" to-day.

South Lancashire.—January 29th. Two-phase motor-generators, boosters, and batteries for the S.L.E.T. and Power Company. See "Official Notices" January 10th.

Spain.—January 26th. The municipal authorities of Sahagun (province of Leon) are inviting tenders until the 26th inst., for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Sahagun (Leon).

Spain.—January 27th. Tenders are being invited by the Spanish Ministry of Public Works in Madrid until the 27th inst., for the concession for the construction and working of an electric tramway between Tolosa and San Sebastian (Guipuzcoa province). Tenders are to be sent to El Ministerio de Obras Publicas, Madrid, whence particulars may be obtained.

Spain.—February 2nd. The municipal authorities of Elgirbar are inviting tenders until February 2nd, for the establishment and equipment of a central electric lighting station in the town. Particulars may be obtained from, and tenders are to be sent to, El Secretaria del Ayuntamiento de Elgirbar, Spain.

Spain.—February 9th. Tenders are being invited until February 9th, by the Municipal authorities of Irun for the concession for the electric lighting of the town. Tenders are to be sent to El Exmeo Ayuntamiento Constitucional, Irun, Spain, whence particulars may be obtained.

Spain.—The municipal authorities of Ondarra (Alicante province) have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Sunderland.—February 6th. 10 double and four single-deck car bodies, trucks, &c. See "Official Notices" January 17th.

Walsall.—January 31st. One each 500-H.P. and 25-H.P. high speed engines, and 350-KW. and 16-KW. dynamos for the electricity department. See "Official Notices" January 17th.

Warrington.—January 28th. Feeder cables for Corporation tramways. See "Official Notices" January 17th.

West Bromwich.—January 29th. Boilers, dynamos, booster, switchboards, condenser, &c. See "Official Notices" January 10th.

Wigan.—February 3rd. Cables and trolley wire. See "Official Notices" to-day.

CLOSED.

Huddersfield.—At their last meeting the Corporation accepted the following tenders for sections of the tramways about to be electrically equipped:—

	Per ton.
Rails—Bolckow, Vaughan & Co.	£6 7 6
Fishplates—Bolckow, Vaughan & Co.	7 17 6
1-in. bolts—Ibbotson Bros. & Co.	14 17 6
⅞-in. bolts—Ibbotson Bros. & Co.	17 15 0
Tie rods—Bolckow, Vaughan & Co.	8 16 3
Soleplates—Bolckow, Vaughan & Co.	7 17 6

Steel points and crossings—Hadfield's Steel Foundry Company, at £2,433 5s. (patent manganese steel).

London.—The London County Council had under consideration on Tuesday the following tenders for providing an electric lighting installation at the reformatory at Farmfield, for female inebriates:—

Anti-Vibrator, Limited (accepted)	£450 0 0
A. H. Marshall & Co.	516 0 0
Buchanan & Curwen	562 10 4
J. G. Statter & Co.	575 0 0
Jackson Bros.	679 16 8
George T. Newling	725 0 0
William Simmons	751 0 0
G. Weston & Co.	795 0 0
John Barker & Co., Limited	825 0 0
T. Henx Duncan	831 12 0
T. S. Marriage & Co.	866 10 6
Tamplin & Makovski, Limited	880 0 0
Barlow Brothers & Co.	890 0 0
C. Peacock & Co.	965 0 0
C. W. Gifkins & Co.	1,174 0 0
T. H. J. Dennis & Sons	1,217 0 0
Simmonds Brothers, Limited	1,384 0 0

Oban.—The *Contract Journal* says that the Corporation has ordered three 60-KW. steam dynamos (vertical enclosed high-speed engines) from J. Howden & Co., of Glasgow, at £1,500, and two boilers and economiser from Babcock & Wilcox at £1,542.

Stirling.—The contract for the supply of motors as advertised by this Corporation, has gone to the Lancashire Dynamo and Motor Company.

FORTHCOMING EVENTS.

Friday, January 24th —At 5 p.m. Physical Society. Meeting at the rooms of the Chemical Society. Paper to be read on "The Factors of Heat." Part I., by Mr. James Swinburne.

At 7.30 p.m.—North-East Coast Institution of Engineers and Shipbuilders. Meeting in the Lecture Hall of the Literary and Philosophical Society, Newcastle-on-Tyne. Mr. J. W. E. Littledale will reply to the discussion on his paper on "The Speed of Machine Shop Tools," and a paper will be read on "Some Notes on Steam Turbines," by Mr. F. J. Warburton.

Saturday, January 25th.—At 6.30 for 7 p.m. Institution of Junior Engineers. Seventeenth anniversary dinner at the Hotel Cecil, the president, Sir John Jackson, F.R.S.E., in the chair.

At 10.0 a.m. Institution of Electrical Engineers (Students' Section). Visit to the works of the India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, Silvertown.

Monday, January 27th. — Institution of Electrical Engineers (Newcastle Section) meeting. Paper on "Sub-station Polyphase Machinery" by Mr. A. Stewart.

Tuesday, January 28th. — Institution of Electrical Engineers (Manchester Section) meeting. Paper by Mr. H. A. Earle, on "The Supply of Electricity in Bulk."

Wednesday, January 29th.—At 7.30 p.m. Institution of Electrical Engineers (Students' Section). Ordinary meetings in the library of the Institution, 28, Victoria Street, Westminster. Paper to be read:—"Notes on Continuous Current Testing," by Mr. S. Glendenning.

Thursday, January 30th.—North-East Coast Institution of Engineers and Shipbuilders. The annual Institution dinner in the Assembly Rooms, Westgate Road, Newcastle-upon-Tyne.

Friday, January 31st.—At 9 o'clock. Royal Institution of Great Britain. Discourse by Prof. A. Crum Brown, F.R.S., "The Ions of Electrolysis."

At 8 o'clock.—Electro-Harmonic Society Smoking Concert.

Saturday, February 1st.—At 2.30 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Willesden Station of the Metropolitan Electric Supply Company.

NOTES.

Poor-Gas Producers.—Referring to "Enquirer's" letter in another column, the small space of the plant at Messrs. Hornes' works struck us also as remarkable, and this constitutes one of the advantages claimed for the system. We are in favour of the generator being below atmospheric pressure for reasons of health and safety, while an inward leak can so easily be stopped. Only a leak inwards beyond the producer would be likely seriously to reduce the efficiency of the gas. The drawing of the gas by the engine does not mean the loss of so much power as is otherwise needed to drive a fan. Poor gas certainly does require somewhat larger engines for an equal duty compared with ordinary illuminating gas. Probably 10 per cent. would cover the increase as a rule. As there is no difference worth arguing over between producer and blast-furnace gas, we might refer "Enquirer" for large engines to various blast-furnace gas power plants, notably at Sheepbridge Ironworks, where two engines of 100 H.P. are at work, and more recently at Claycross Works, near Chesterfield, where a 300-H.P. blowing plant is running on the Thwaite-Gardner system. We believe an independent test of this plant is under consideration, but a general test of several generators of producer gas would involve considerable expense, and could only be carried out by joint action.

Correspondence Instruction.—Prof. Andrew Jamieson, M.Inst.C.E., has started electrical and mechanical engineering correspondence classes. His success as an author of engineering books, and his long and tried experience as a teacher and consulting engineer are well known. This course of instruction is specially suitable to young engineers engaged in central station duties or during their apprenticeships, and to all engaged in mechanical pursuits, who reside at too great a distance from, or who do not desire to attend, public classes.

National Electrical Contractors' Association.—A general meeting of the National Electrical Contractors' Association was held in Anderton's Hotel, Fleet Street, E.C., on Monday evening, the 20th inst., at 7 o'clock, Mr. W. R. Rawlings, A.M.I.E.E., in the chair. Reports were submitted by the secretaries of the metropolitan and a number of the provincial associations. The constitution and rules, as drawn up by the general committee appointed some time ago, were submitted and approved. The following office-bearers were appointed for the ensuing year:—

President.—W. R. Rawlings, London.

Vice-Presidents.

N. H. Beilby, West Hartlepool.	C. L. Troup, London.
H. Bland, Newcastle-on-Tyne.	M. Wallis, Leeds.
A. E. Porte, Dublin.	T. Wright, Glasgow.

Hon. Treasurer.—H. Marryat, 28, Hatton Garden, London, E.C.

Secretary.—Thos. Guthrie, C.A., 46, Queen Victoria Street, London, E.C.

The central board will consist of these officers and other members to be elected forthwith by the metropolitan and provincial associations from amongst their own members.

Personal.—On Saturday, January 17th, the staff of the Wycombe (Borough) Electric Light and Power Company, Limited, presented Mr. Walter Barnes, the secretary, with an illuminated address and a case of fish servers, on the occasion of his leaving Wycombe to take up the position of secretary to the Harrow Electric Light and Power Company, Limited. The chief engineer and manager (Mr. W. E. Brandreth), in making the presentation, referred in eulogistic terms to Mr. Barnes's work for the Wycombe Company. Mr. Barnes acknowledged the gift in suitable terms.

Mr. S. Joyce, who has for the past four years or so been manager at the Broadheath plant factory of the Edison & Swan Company, and latterly at Ponder's End works, is shortly relinquishing that position.

The first annual "staff" dinner of the Cardiff employés of the National Telephone Company was held last Saturday at Barry's Hotel, Cardiff. Mr. H. Bell, the district manager, presided.

Mr. Wm. Wharam, whose impending retirement from the position of general manager of the Leeds City Tramways is announced, was appointed secretary of the old Leeds Tramways Company 29 years ago, two years after tramcars first appeared in Leeds.

An American Exhibition.—It seems that there is every prospect of the Exhibition of American Arts and Industries, which is to be held at the Crystal Palace this summer, being a success. American machinery, and especially electric traction plant and apparatus, are expected to be well in evidence.

Obituary.—We regret to announce the death of Mr. C. E. Stuart, late Controller of Telegraph Stores to the G.P.O., whose retirement was recorded only a few weeks ago.

Electrical Trades Dinner.—On Friday last at the Restaurant Frascati about 120 representatives of various branches of the electrical industry sat down to a dinner at the invitation of a committee who are aiming at setting on foot an organisation of the trade for social intercourse and interchange of opinions on subjects in which its members are specially interested. The chair was taken by Mr. Charles F. Quicke, M.I.E.E. Although the invitation led one to suppose that a scheme of some sort would be submitted for approval, the ruling character of the evening's proceedings was conviviality, any serious consideration of the nature and aims of the new association being deferred to a future meeting of which the date is not yet fixed. The names of those present were registered in order that each one should have notice of the coming meeting. The large number brought together at the dinner on Friday seems to indicate a general desire for some kind of social organisation, and we shall be pleased to record further developments.

Yorkshire College Engineering Society.—On Monday, January 13th, Mr. Konrad Andersson, of the English De Laval Steam Turbine Company, delivered a lecture to this society on the "De Laval Steam Turbine."

The Electrical Volunteers.—We are glad to be able to state that the services of the Corps of Electrical Engineers R.E. at the front are appreciated by the military authorities in South Africa. This is shown by the fact that the following appointments have been made officially:—

Sapper G. Francis, of the Corps of Electrical Engineers, now in South Africa, has been appointed an assistant electrical engineer under the Public Works Department of the Transvaal at a salary of £315 per annum, and is stationed at Johannesburg.

Corporal J. Coxon, of the Electrical Engineers R.E. now in South Africa, has been appointed to the electrical staff of the Imperial Military Railways, at a salary of £270 (rising to £400) per annum. He is stationed at Johannesburg.

The fact that these appointments have been made should be a great encouragement to those wishing to join the Electrical Engineers R.E. (Vol.) for active service in South Africa. We understand that one, if not two, new detachments may be required shortly.

Copper and Cable Prices.—The London Electric Wire Company, Limited, announce that owing to fall in the price of H.C. copper, a further discount of 10 per cent. is being allowed on electric light and power wires and cables.

Electrical Contractors and Municipal Traders.—The first general meeting of the newly formed northern section of the National Association of Electrical Contractors took place on Saturday in Manchester. As explained by the Chairman (Mr. H. Bland), the Association is a combination formed to defend the interests of the electrical industry. Many attacks were now being made on that industry by the municipalities and by other bodies with conflicting interests. The manual workers in the trade were now combining in every town, and it had become necessary for the masters to combine also, so as to meet the men in a united body. As to municipal trading, Mr. Bland pointed out that many corporations are now using their powers of expenditure for the purpose of competing in trade against that section of ratepayers who were engaged in the electrical industry. Of course, the corporations were able to undersell the private contractors in every case, for if a loss resulted it could always be made good out of the rates. Parliament never intended the municipalities to use their powers in this way. Municipal enterprise was rapidly growing, and if the electrical contractors delayed much longer, they would combine too late to effect much good. A resolution moved by Mr. Wallis (Leeds), and seconded by Mr. Richardson (West Hartlepool), was adopted, calling upon the London Association to take action in conjunction with kindred associations for the purpose of defining the limits of legitimate municipal enterprise as regards electrical work, and strengthening the hands of those who are unfairly exposed to competition by municipal and other authorities trading under Parliamentary powers.

Concert.—A smoking concert of the Electrical Engineers R.E. Volunteers was held at headquarters on Wednesday last week.

Royal Institution.—On Friday last Lord Rayleigh delivered a discourse on "Interference of Sound," before this Institution.

Institution of Mechanical Engineers.—Last Friday Mr. H. F. L. Orcutt read a paper on "Modern Machine Methods."

National Physical Laboratory.—The work of preparing Bushey House for the National Physical Laboratory is now approaching completion and, at the request of the President and Council of the Royal Society, His Royal Highness the Prince of Wales has fixed Wednesday, March 19th, for the opening ceremony. The object of the laboratory is to encourage the applications of physical science to manufactures and industry. This it will do by undertaking researches into questions of importance to either and by testing apparatus and material used in trade.

Appointments Vacant.—Mains superintendent at £150 for Harrogate, also switchboard attendant for the same station. Assistant lecturer and demonstrator in electrical engineering for the North Wales University College at £120. An assistant electrical engineer is wanted by the Stalybridge, Hyde, Dukinfield and Mossley tramway and electricity board; the same authority requires an electrical and mechanical draughtsman.

Lectures.—On 11th inst. Mr. A. W. Heaviside delivered a lecture in the College of Science, Newcastle, on "Telegraphs and Telephones."

At Glasgow, on 17th inst., Mr. F. B. Behr lectured to the members of the Glasgow Technical College Scientific Society on "Manchester and Liverpool High-Speed Electrical Railway."

Mr. Sydney F. Walker gave a lecture on Sunday last, for the Sunday Lecture Society, at St. George's Hall, on "Electric Waves," to a full audience. The apparatus exhibited was that of Mr. Neville Maskelyne, the special feature of which is the use of a closed resonator circuit, in place of an open circuit as used by Marconi.

Electro-Harmonic Society.—The next smoking concert will be held on Friday, 31st inst., at St. James's Hall Restaurant (Banqueting Hall). Judging from the programme the concert should be an excellent one. Songs will be rendered by Mr. Frank Tebbutt, and Mr. Arthur Strugnell; violin and piano solos and duetts, by Mr. T. E. Gatehouse, and Mr. A. E. Izard; whistling solos, by Mr. Charles Capper; sleight of hand, by Dr. Byrd-Page; recitations, by Mr. Ernest Meads; humorous songs, by Mr. F. W. Stephens; and humorous sketches, by Mr. Chas. Frood.

THE CENTRAL STATION ENGINEER.

Personal.—The following changes are taking place in the Harrowgate Electricity Works:—Mr. F. L. OGDEN has obtained a position of assistant engineer at Oldham. Mr. G. F. A. NORMAN has resigned his position as mains engineer in order to shortly take up other duties in South Africa. Mr. Norman has been with the Corporation for over six years, and he takes with him all the good wishes of the members of this department for his future welfare.

The Mansfield Town Council, on the recommendation of the Electricity Committee, has appointed Mr. TONGE clerk of the works at a weekly salary of £3 13s. 6d.

On the occasion of his leaving Belfast to take up a position as engineer-in-charge at the new Corporation Electricity Works, Salford, Mr. E. T. WILLIAMS was recently presented with a handsome case of razors and shaving tackle, by the members of the electricity department. He held a similar position at Belfast.

CITY NOTES.

City and South London Railway Company.

THE directors' report for the half-year ending December 31st, 1901, to be submitted to the meeting, to be held at 71, Finsbury Pavement, E.C., on Tuesday, January 28th, at 12 o'clock noon, reads as follows:—

"The receipts from all sources for the past half-year have amounted to £62,601 4s. 8d., and the cost of working has been £29,257 16s. 2d., leaving a profit of £33,343 8s. 6d. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £34,076 5s. 2d. After making provision for the debenture stock interest, and the transfer to the renewal fund of £2,000, a balance remains available for dividend of £23,560 17s. 8d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896, and 1901, and that a dividend at the rate of 2¼ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, and on the ordinary shares from November 17th, leaving a balance of £1,424 12s. 8d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year.	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).
		£ s. d.
Ended December 31st, 1890 (11 days)	165,000	1,568 3 9
" June 30th, 1891	2,412,343	19,403 6 9
" December 31st, 1891	2,749,055	19,798 16 6
" June 30th, 1892	2,813,162	20,931 4 2
" December 31st, 1892	3,117,602	22,002 17 5
" June 30th, 1893	3,146,656	22,458 6 9
" December 31st, 1893	3,093,351	22,067 14 10
" June 30th, 1894	3,383,154	23,564 10 6
" December 31st, 1894	3,275,649	23,540 12 4
" June 30th, 1895	3,113,199	23,711 5 8
" December 31st, 1895	3,172,488	23,780 3 7
" June 30th, 1896	3,192,672	24,021 13 0
" December 31st, 1896	3,368,480	25,456 6 9
" June 30th, 1897	3,437,810	26,403 3 6
" December 31st, 1897	3,337,861	25,472 12 10
" June 30th, 1898	3,478,977	26,356 16 4
" December 31st, 1898	3,462,814	26,319 14 10
" June 30th, 1899	3,540,098	26 749 3 0
" December 31st, 1899	3,442,942	26,197 14 10
" June 30th, 1900	4,169,717	33,608 2 3
" December 31st, 1900	5,018,842	44,716 3 11
" June 30th, 1901	5,887,786	51,013 17 3
" December 31st, 1901	7,008,842	59,734 14 8
Total since the opening of the line ..	79,788,450	£618,877 5 5

Railway opened for traffic December 18th, 1890.
Extension to Moorgate opened February 25th, 1900.
Extension to Clapham Common opened June 3rd, 1900.
Extension to Islington opened November 17th, 1901.

"The directors feel justified in congratulating the proprietors on the result of the half-year's working. The extension to Islington was opened for public traffic on November 17th, and the increase in the receipts since that date has been satisfactory. The subway at London Bridge, connecting the platforms of this company with those of the Brighton Railway, was completed and opened on December 2nd, and is being largely used and arrangements for through bookings on the lines of the two companies are now being made. The working stock of the company has been increased by 36 carriages and 10 locomotives. An additional carriage has been added to all the trains and materially assists in coping with the traffic in the busy hours of the day. In order to meet the increasing traffic it has been found necessary to order 16 more carriages which are now in course of construction. In accordance with the authority given them at the last meeting, the directors have issued £150,000 of the 5 per cent. preference stock, 1901, enabling them to pay off loans and provide for other capital expenditure. The arbitration respecting St. Mary Woolnoth Church remains still unsettled, and it is feared that some time will elapse before a final conclusion is arrived at. The Islington and Euston Bill was favourably reported upon by the Joint Committee, and now waits the sanction of Parliament in the usual course. The increased traffic from the stations south of the Thames is making it difficult to deal with the growing traffic at the London Bridge station, and the only way of affording relief is by constructing a station at London Bridge on the portion of the old line at present disused, so giving an alternative route to the City. To do this economically it is necessary to extend the disused line for some distance; and to effect this, arrangements have been made with the City and Brixton Company to abandon the larger of their railway, constructing only the short piece as far as Lambeth, cancelling the old agreement with this company and substituting a new one to meet the altered conditions, which will be submitted for the approval of the proprietors at the special meeting. At the special meeting to be held at the conclusion of the ordinary meeting, the proprietors will be asked to sanction the conversion of the ordinary shares, 1899 and 1900 issues, into consolidated ordinary stock of the company. Interest at the rate of 3 per cent. per annum will be paid, as hitherto, out of a capital on the ordinary shares, 1899 and 1900, up to the opening of the extension to Islington, and from that date up to December 31st, they will rank for dividend, *pari passu*, with the ordinary stock. The warrants for interest and dividends will be posted on the 11th prox. The directors retiring by rotation are Mr. Charles Seymour Grenfell and Mr. Edwin Tate, who are eligible for re-election. The auditor retiring is Mr. James L. Oliver, who offers himself for re-election."

Direct United States Cable Company.

THE directors' report for the six months ended December 31st, 1901, to be presented at the meeting to be held at Winchester House on Tuesday, January 28th, at 2 p.m., reads as follows:—

The usual statements of account for the half-year ended December 31st, 1901, are submitted herewith. The half-year's revenue, after deducting out-payments amounted to £49,588 17s. 1d. as compared with £50,533 16s. 1d. for the corresponding period of 1900, showing a difference of £944 19s. against the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of cable repairs, amounted to £21,558 0s. 10d., leaving a balance of £28,030 16s. 3d. as the net profit, making with £3,532 5s. 8d. brought forward from the previous half-year a total of £31,563 1s. 11d. For the corresponding period of 1900, the working expenses and other payments amounted £20,826 11s. 5d. Interim dividends of 3s. per share, for the quarter ended September 30th, 1901 (paid October 26th, 1901), and of 3s. per share for the quarter ended December 31st, 1901 (payable January 31st, 1902) together amounting to £18,213 have been declared, and after setting aside £10,000 to the reserve fund account, the balance of £3,350 1s. 11d. on the revenue account has been carried forward. The reserve fund account has been debited with £47 1s. 2d. balance of cost of cable repairs, and after being credited with interest on the investments, profit on sale of securities and amount set aside from revenue, the balance of the account, taking the investments at cost price, now amounts to £148,016 19s. 11d. The meeting of the International Telegraph Conference in London has been further postponed until the summer of 1903.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Wednesday, January 29th, Marconi's Wireless Telegraph Company, Limited—further issue of 12,736 shares of £1 each, fully paid, Nos. 137,084 to 149,819. Wednesday, February 5th, British Electric Traction Company, Limited—further issue of 37,926 ordinary shares of £10 each, fully paid, Nos. 122,075 to 160,000, and 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 190,001 to 200,000. The Committee has also ordered the undermentioned securities to be quoted in the Official List:—British Electric Traction Company, Limited—further issue of 37,926 ordinary shares of £10 each, fully paid, Nos. 122,075 to 160,000; and 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 190,001 to 200,000. Commercial Cable Company—further issue of £100,180 sterling 500-year 4 per cent. debenture stock (redeemable).

Dublin United Tramways Company.—At a meeting held on Tuesday, the directors recommended a dividend for the half-year ending December 31st, 1901, at the rate of 6 per cent. per annum on preference shares, and at the same rate on ordinary shares. £1,000 was written off from the preliminary expenses, and £4,833 16s. 7d. carried forward; the whole being subject to final audit. Mr. Stanley Beeton and the Hon. Percy B. Bernard, D.L., have been co-opted to the vacancies on the board caused by the death of Mr. J. F. Lombard, and the resignation of Mr. J. B. Concannon.

Central London Railway.—The directors recommend dividends for the half-year ended December 31st, at the rate of 4 per cent. per annum on the undivided ordinary stock, and 4 per cent. per annum on the preferred stock; and 4 per cent. per annum for the whole year on the deferred stock. The sum of £10,000 is transferred to the reserve fund, and £5,870 carried forward.

St. James's and Pall Mall Electric Light Company.—The directors recommend a dividend for the half-year ending December 31st, of 7s. 6d., together with a bonus of 2s. per share on the ordinary shares making with the interim dividend 12½ per cent. and a bonus of 2 per cent. for the year 1901.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Jan. 17th were £625; corresponding week last year, £552; increase, £73. Total to date, £1,574; corresponding period last year, £1,368; increase £206. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending January 18th were £156; corresponding week last year, £127; increase, £29. Total receipts to date, £424; corresponding period last year, £391; increase, £33.

Bristol Tramways and Carriage Company.—The receipts for the week ending January 17th were £3,913; corresponding period last year, £3,747; increase, £166.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending January 10th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon*	621	423	—	1½	886	555	—
Devonport	407	—	—	1½	594	—	—
Dudley—Stourbridge	602	175	—	1½	835	617	—
Gateshead	589	—	—	1½	907	—	—
Greenock-Pt. Glasgow	343	193	—	1½	666	278	—
Hartlepool	169	19	—	1½	268	27	—
Kidderminster ..	91	14	—	1½	126	9	—
Merthyr	176	—	—	1½	246	—	—
Oldham—Ashton ..	454	54	—	1½	657	14	—
Poole	177	—	—	1½	257	—	—
Potteries	1,318	77	—	1½	1,926	—	64
Southport†	113	23	—	1½	177	9	—
South Staffordshire	719	131	—	1½	995	59	—
Swansea	399	60	—	1½	573	41	—
Taunton	54	—	—	1½	79	—	—
Tynemouth	175	—	—	1½	283	—	—
Wolverhampton Dist.	85	48	—	1½	112	53	—

* Partly horse. † Partly steam.

The aggregate receipts to date are for 10 days this year, as against 11 days last year.

Central London Railway.—The receipts for the week ending Jan. 18th were £6,808; corresponding week last year, £5,982; increase, £826. Total receipts to date, £19,580; corresponding period last year, £17,505; increase, £2,075. Miles open, 6.

City and South London Railway.—The receipts for the week ending Jan. 19th were £2,937; corresponding week last year, £2,002; increase, £935. Total receipts to date (3 weeks), £9,147; corresponding period last year, £6,073; increase, £3,074. Miles open, 6¼; last year, 4¾.

Dover Corporation Tramways.—The receipts for the week ending January 18th were £165 5s. 5½d.; corresponding week last year, £163 12s. 4½d.; increase, £1 13s. 1d. Total to date, £478 2s. 0d.; corresponding period last year, £465 5s. 4d.; increase, £12 16s. 8d. Miles of track open, 3. Car miles run, 1902, 5,098; 1901, 4,969. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending January 17th were as follows:—D.U.T. Co., electric cars, £3,332 7s. 2d.; D.S.D. Co., electric cars, £678 15s. 7d.; total, £4,011 2s. 9d.; corresponding week last year—D.U.T. Co., electric cars, £3,254 15s. 8d.; ditto, horse cars, £6 0s. 4d.; D.S.D. Co., electric cars, £686 13s. 8d.; total, £3,947 9s. 8d.; increase, £63 13s. 1d.; aggregate to date, £10,289 10s. 3d.; aggregate to date last year, £9,705 19s. 9d.; increase, £183 10s. 5d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and 2 miles by horses for the corresponding period last year.

Glasgow Corporation Tramways.—Week ending January 18th, £10,111, compared with £8,494 for corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending January 19th were £1,397; corresponding week last year, £1,482; decrease, £85. Total to date, £4,252; corresponding period last year, £4,537; decrease, £285. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

IN the Money Market, brokers are allowing the rates to keep steady, but do not appear anxious to enter into large commitments pending the announcement by Parliament as to how the latest phase of the war is to be financed. Consols, with one eye on Lombard Street, are a little better at a fraction over 94, and in spite of the disappointing character of the last few "steam" dividends, Home Rails are mostly steady. Investment stocks continue in quiet demand. Day by day the stockbroker receives letters asking for advice in the selection of securities wanted for investment, and the electric lighting list is in pretty constant requisition for this purpose. There is a quartette of rises to record, and no decline. Telegraph varieties are still in a state of hesitancy, but in the miscellaneous section higher prices are the general rule. There is nothing doing in telephone issues, and the electrical railway market boasts one small appreciation, the Central London dividend having had no effect on Twopenny Tube prices.

Taking telegraphs first, we note with considerable satisfaction that our repeated cry for narrower quotations in the Official List is at last being heard. For instance, Globe Telegraph Ordinary are now sent out at 9¼ to 9⅜, instead of 9—10. Western Telegraph shares, instead of being called 12—13 are 12⅛—12⅜. Better still is the compression of the prices of Anglo-American Ordinary and Preferred within the compass of 2 per cent. instead of 3. Our readers will note other instances. In following out our suggestions the jobbers in the market furnish not only more reliable (or, it would be better to say, less unreliable) quotations, but they encourage business, and thereby serve their own interests. The average investor has no love for that security in which he finds a ridiculously wide margin quoted, even though he be assured that a narrower market can be found in the Stock Exchange. There remains, however, plenty of room for still further reform, and we hope that it will not be long before the electric supply department undergoes a similar alteration in its price list.

Of the fluctuations other than those caused by marking securities *ex* dividend, Cuba 10 per cent. Preference shares are down ½, the unsettled condition of the island under Yankee rule forming a reason for several sales. In the Eastern group, "Chinas," after receding ¼, picked it up again, so that, allowing for the dividend deduction of 2s. 6d., the price is better on the week. Eastern Ordinary is also *ex* dividend, and the price is 127½, the distribution being at the usual rate of 1¼ per cent. for the quarter. Great Northern shares are quoted with £1 margin instead of £2, and the medium price remains the same. Submarine Cables Trust certificates continue dull, the apathy of the American market causing cable sales in New York. Anglo descriptions are virtually without alteration, the Preferred showing a small advance, but West Coast of America Debentures have soon dropped their 2 per cent. gain of last week. As noted above, the Telephone market is inanimate.

Coming to supply shares, three of the London Companies' Ordinary are each 10s. better—to wit, Citys, Metropolitans, and Westminsters. There is quite a fair amount of speculation going on round City of Londons. Westminsters owe their rise to the clearing up of the new whole shares recently issued. The fractions are still with us, and a good deal of business is passing in them at about 1s. 6d. to 2s. premium per eleventh. Edmundson's have recovered the dividend of 2s. 6d. deducted on last Account day. The St. James's and Pall Mall dividend and bonus make altogether a distribution of 14½ per cent. for 1901.

In the electric railway division there is a rise of 5s. in City and South London shares, whereby their value is more nearly approximated to that of the stock. The company's report is considered favourable, and very possibly the price of the stock would have risen further had it not been for the damping effect of the Brighton Railway distribution. Metropolitan stock improved a trifle—to 77, upon the declaration of a dividend at the rate of 2¼ per cent., the same, it will be noticed, as that of the City and South London Company. But whereas the latter paid an interim dividend at the rate of 1⅛ per cent. per annum last July, the Metropolitan proprietors received at the rate of ½ per cent. more. Metropolitan District stock is about 28½. There is a little doing in East London at 6¼, and it seems almost time for the stock to have its annual transitory flare-up. The Central London dividends of 4 per cent. are what were expected, and must be deemed highly satisfactory, but the quotations do not respond so far.

British Electric Preference are ¼ better on the progress of the company, and business in these is brisker than it was in the Ordinary. The last-named are to be bought at 14½. Anglo-Argentine trams have smartly recovered at £4 middle and Cape Electric Trams at 2⅛ are *ex* both dividend (1s. 2⅜d.) and right to subscribe for the new shares. Brisbane Preference are commanding attention at 4⅜, and a buyer of New General Traction Ordinary shares had to pay 3 1/16 for them on Tuesday. Potteries Ordinary are changing hands in the vicinity of 11¼.

The Miscellaneous Market is noteworthy for another jump of 10s. in British Insulated Wire shares, making £2 in less than a fortnight. Rumours of an amalgamation with the Telegraph Manufacturing Company are responsible for most of this. The Preference shares, *ex* dividend, are unchanged, and the Debenture stock is wanted at 104. Brush Preference quickly overtook the ⅛ that fell off last week, and Telegraph Construction shares show a tendency to harden. Westinghouse Preference are 5⅜; by a slip they were quoted at 7⅞ in our last issue. British Thomson-Houston shares are 14 to 15, and London United Tramways new Preference command £1 premium, while the new Debentures are 2 premium which is a point below the price of the old stock.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Jan. 15th.	Closing Quotations Jan. 22nd.	Business done during week ended Jan. 22nd. 1902 Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	97 —101	97 —101	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 4,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	...	47 — 50	48 — 50	...	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	...	89 — 92	90 — 92	90½	89
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	...	7⅞— 8¼	7⅞— 8¼	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	92 — 96	92 — 96	...	...
16,000	Cuba Telegraph	10	7 %	...	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13½— 14½	13 — 14	13½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10 xd	10	9½
101,300	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	125 —135	124 —129	128	123½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	88 — 92	88 — 90	88½	87
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 —112	108 —112	111	108
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	12½— 13½	12½— 12⅝xd	12⅝	12½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9 — 10	9½— 9⅝	9 1/16	8¼
180,042	Do. do. 6 % Pref.	10	...	...	...	13 — 14	13½— 13¾	13¾	13
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	27 — 29	27½— 28½	28½	27 5/16
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	38 — 42	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs. ...	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	...	3⅜— 3⅝	3⅜— 3⅝	3⅝	3 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	...	4¾— 5	4¾— 5	4⅞	4¾
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	94 — 97	94 — 97	95	94¼
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	...	101 —105	101 —105	104	103½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	15/16—1 1/16	15/16— 1 1/16	15/16	7/8
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	120 —125	117 —121	115	...
58,000	United River Plate Telephone	5	7 %	...	...	4⅜— 5½	4⅜— 5½	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— ⅝	½— ⅝	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	12 — 13	12¼— 12⅜	12⅝	12¼
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	101 —104	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	⅜— ⅝	½— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 4	3 — 4	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 —102	97 — 102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	...	8⅜— 9¼	8⅜— 9¼	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8⅜— 9¼	8⅜— 9¼	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	...	8 — 9	8 — 9	8⅜	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	103 —105	104½	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	...	5½— 6	5½— 6	5⅝	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	108 —111	108 —111 xd	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	...	8½— 9½	9 — 10	9⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	121 —126	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104 xd	101 —104	102⅜	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	9½	9⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	12½	12¼
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	105 —108	107	106
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	5½— 6	5½— 6	5⅞	5⅝
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	5¾	5½
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	106 —109	106⅜	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	11⅜	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	103 —106	103 —106	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	4¼	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	..
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	14 — 15	14½— 15½	14⅞	14 13/16
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	...	15 — 16	15 — 16	15½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15½— 16½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	...	11½— 12½	12 — 13	12 11/16	12 7/16

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
¿Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Jan. 15th.	Closing Quotation Jan. 22nd.	Business done week ended Jan. 22nd, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	87 — 91	...	...
62,074	British Electric Traction	10	8 %	9 %	...	14 — 15	14 — 15	14¼	14 5/16
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12¼ — 12⅜	12 11/16	12⅛
600,060£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128½	126¾
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	9 — 10	9½ — 10⅛	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	⅞ — 1	⅞ — 1	1⅛	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	1 1/16 — 1 1/16	1 1/16 — 1 1/16	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	1½	1 7/16
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	1⅞ — 2⅛	2 — 2¼	2⅛	2⅜
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	104¼	103
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	16½ — 17½	16½ — 17½	17 5/16	17
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	5⅞	5⅝
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114	110 —114	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	105 —108	105 —108	107⅞	103½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	105 —108	105 —108	106	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	106 —109	106 —109	107	...
855,000	City and South London Railway	Stock	1⅞%	1½%	2 %	65 — 67	65 — 67	67	65½
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	6 — 6¼	6 — 6½	6½	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	3⅜	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅜ — 2¼	1⅜ — 2¼	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	97 —101 xd	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜—10¼	9⅜ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	...	16½ — 17½	16½ — 17½	17 7/16	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½ — 6	5½ — 6	5⅝	5 9/16
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	...	...	20 — 21	20½ — 21½xd	...	...
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	...	4⅜ — 5	4⅜ — 5	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11¼ — 11⅜	11¼ — 11⅜	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ — 16½	15½—16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	...	34 — 38	35 — 38	36	34
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...%	...	...	102 —104	102 —104	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	10⅝	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	...	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ¼—½.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10¾—10⅞.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, January 22nd.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	23/-	23/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	30/-	30/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19 5	£19	5s. inc.
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C),	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	125/-	125/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb.	2¼d.	2¼d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	
c Brass (rolled metal 3" to 12") basis	per lb.	7d.	7d.	..
c „ Tube (brazed)	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) ..	per lb.	7¾d.	7¾d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	9½d.	9½d.	..
c „ „ (solid drawn) ..	per lb.	9½d.	9½d.	..
g Copper Bars (best selected) ..	per ton	£66	£66	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£66	£66	..
g „ Rod	per ton	£66	£66	..
e „ Electrolytic) Bars ..	per ton	£55	£70	£15 dec.
e „ „ Sheets ..	per ton	£70	..	‖
e „ „ Rod ..	per ton	£63	£75	£12 dec.
e „ „ H.C. Wire	per lb.	8d.	8½d.	½d. dec.
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
m German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/4 to 3/5	3/4 to 3/5	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	44/10	44/3	7d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 10	£9 10	..
g Lead, English Ingot	per ton	£11 to £11 2 6	£10 10 to £10 15	inc.
g „ „ Sheet	per ton	£13 10	..	..
m Manganin Wire No. 26	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£110 to £111	£107 10 to £108 10	£2 10 inc.
g „ foil	per lb.	1/6	1/6	..
m „ wire, Nos. 1 to 15	per lb.	1/5	1/5	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
f Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
f „ 6 lea. Flax	per lb.	5½d.	5½d.	..
f „ 8 ply 10 lbs. Russian ..	per lb.	4½d.	4½d.	..
f „ 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
f „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£21 10	£21 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggin & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare, [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

(*Concluded from page* 114.)

REPORT OF THE COMMITTEE ON MANUFACTURING ON THE VISIT OF THE INSTITUTION TO GERMANY IN 1901.

(*Read January 9th*, 1902.)

For convenience, the matter dealt with has been grouped under the following headings:—

1. Financial.
2. Works management.
   - (*a*) Buildings.
   - (*b*) Staff.
   - (*c*) Labour.
   - (*d*) Treatment of employés.
   - (*e*) Machine tools.
   - (*f*) Driving of shops.
   - (*g*) Miscellaneous.
3. Design, &c.
   - (*a*) Switchboards.
   - (*b*) Direct-current dynamos and motors.
   - (*c*) Alternators and alternating-current motors.

1. FINANCIAL.

This question possesses considerable interest, as, at the time of the Institution visit, the German electrical industry was passing through a severe financial crisis. It would appear that the German Group Banking System, while enabling firms to start with ample capital, and, therefore, also with well-equipped works, has the disadvantage of fostering over-extension and over-production to such a degree that a period of trade depression becomes hard to face. The early summer of this year saw the collapse of two important industrial banks, and with them of one well-known electrical firm. A strain was thrown upon the whole industry, and, under the circumstances, it seems doubtful whether the system is really such an unmixed blessing as some would appear to suppose.

The large and well-equipped works which are possible under this system have, of course, the advantage of reduced shop and management charges. Furthermore, specialised machine tools can be economically employed, and the staffs can be more highly paid, while the heads of departments may specialise to a greater extent. Whether, however, there is much gained in this direction after a certain size has been reached would appear doubtful.

The financial relations which exist between the manufacturers and the banks on the one hand, and their customers on the other, would appear to be so extremely complicated that progress is to some extent retarded, though the system undoubtedly enables experiments to be carried out on a much larger scale than would otherwise be possible.

It is a very noticeable fact that the consulting engineer occupies a much less prominent place in Germany than he does in this country, owing, it would seem, to the same cause. It might almost be said, in fact, that the entire consulting work of Germany is carried out by two engineers, one of whom, be it stated, spent the greater part of his professional life in England.

2. WORKS MANAGEMENT.

(*a*) *Buildings.*—Large works follow from large undertakings. There are two distinct ways of erecting large works. Of the first of these, which consists in building one large shop, the Allgemeine Elektricitäts Gesellschaft, of Berlin, is a typical example, while Messrs. Schuckert's Nüremberg factory may be taken as representative of the plan of splitting up the works into several relatively smaller buildings. Each system has its advantages, and up to a certain size no doubt the ease with which material can be handled and transferred from one department to another, the accessibility of every department and the general compactness, tell in favour of the first method. After a certain size, however, these advantages are less marked, and against them must be set the fact that it is almost impossible to extend one department without in some way encroaching upon another. Further, there is more chance of friction between heads of neighbouring departments where boundaries are to a large extent imaginary. It may be of interest to note that in America the Westinghouse Company lean to the large building plan, while the General Electric Company split up their works, on the second principle mentioned.

As regards the organisation of departments, again two methods are possible. First, certain articles can be manufactured throughout in one department, or, secondly, all work of a similar nature, no matter for what purpose, can be carried out in the same department. Of the first system the Union Elektricitäts Gesellschaft, of Berlin, would appear to be the best example, while perhaps the A.E.G. instrument factory in Akerstrasse, Berlin, and Messrs. Siemens and Halske's telegraph factory in Markgrafenstrasse might be included. The second method, however, seems to be by far the most general.

(*b*) *Staff.*—One of the most noticeable features in all the works visited was the very large engineering staff employed. Out of five firms of whom inquiries were made on this point the following were the proportions of staff to employés: 1 to 20; 1 to 7; 1 to 10; 1 to 13; 1 to 20.

It was somewhat difficult to find out exactly what was meant by "staff," and it is possible that the above figures in many cases include some of the commercial department. Probably, however, after making all allowances, the average proportion would be one engineer to every ten men. The above figures do not include foremen, but engineers only. In the case of one of the largest firms, the foundry, which employs 200 men, has a technical staff consisting of a director, two assistant chemists, and two assistant electricians, to say nothing of the usual clerks and foremen. The only explanation of these large staffs is either that the work done per man is less than with us or that much greater care is given to experimental detail and general testing. While the first explanation is, no doubt, in part correct, it is to be feared that the second is the main cause.

Throughout some works small test-rooms were to be found scattered about, in which the various parts were carefully tested electrically as well as being merely "inspected." The result has been found to be a great saving of labour in the end.

It may be mentioned that owing to the excellent preliminary education obtained by all classes and to the great facilities given for technical education, the competition for subordinate posts of this description is great, and salaries are correspondingly small.

A point of interest is that in most drawing offices the draftsmen are distinct from what may be termed "calculators," who collect and prepare for use by the draftsman the various data required. The mere recording of undigested results being of small value, the calculator would appear to be a most useful innovation.

Another cause for the large staffs is that, as previously stated, much of the work done in this country by the consulting engineer is in Germany carried out by the contracting firm. As an example, it may be mentioned that the design of the overhead permanent-way construction for the Berlin Elevated Railway was got out by Messrs. Siemens & Halske's drawing office. While the commercial and technical departments appear to be kept quite separate, the head of each department is chosen for his commercial as well as for his technical abilities. The sales department appears usually to be in touch with the works only through the medium of the firm's catalogue. The staff hours are from seven to seven and a half hours per day.

(*c*) *Labour.*—Much difference of opinion seems to exist as to whether the German mechanic shows, or does not show, that soldier-like smartness and discipline with which he is usually credited. It was generally acknowledged that the output per man is less than that in England, while a considerable time seems to be wasted both in getting to work and in leaving off. Time recorders were noticeable in nearly all the shops visited.

As to the hours of working, in Berlin itself nine or ten hours, with two hours off in the middle of the day, would appear to be the rule. In the outskirts of the town there is a nine or ten hours' day, with two breaks, of three-quarters of an hour and half an hour respectively, while in the country eleven and twelve hours' work is still usual.

Little information is available as to the rate of wages earned by mechanics, but the following wages paid at the Berlin Central Station, working ten-hour shifts, may be of interest:—

Drivers and dynamo attendants receive 4d. to 4⅜d. per hour.
Stokers, 4¼d. to 4½d. per hour.
Switchboard attendants, 4½d. to 5½d. per hour.
Unskilled labour, 3⅜d. per hour.

It may mentioned that dynamo attendants and drivers are not above cleaning their dynamos and engines, and even scrubbing the floors of the engine rooms. Piece-work seems to be very little used, day-work being almost universal. As a rule each man appears to work two machine tools, while in one instance a man was attending to no less than six. Female labour is extensively employed, but no data as to wages are available.

(*d*) *Treatment of Employés.*—Large and comfortable dining-rooms, &c., are invariably set apart for the staff, but the most noticeable feature is the great care and thought devoted to the safety and comfort of the men. First, every precaution is taken in the way of guarding and fencing in the machines, the law in this respect being very stringent; and, secondly, every convenience is provided to enable the men to wash and get tidy before leaving the works. Besides washing arrangements, at various points about the works, a locker (preferably provided with wire netting sides, so as to be open to inspection) is allotted to each man in which to leave his clothes, and one firm at least allows its men ten minutes of its own time for washing, &c. Reading rooms and various clubs are organised, and in winter coffee can be obtained in each shop. The catering for the latter, which was undertaken at first by the firm, has since, in most cases, been taken over by the men.

(*e*) *Machine Tools.*—Most of the works are well equipped with machine tools capable of dealing efficiently with large work, but the tools for medium-sized work appear less suitable and not as a rule particularly well handled. There was an almost entire absence of automatic machinery, which, considering the large size of the works and the high pitch to which standardisation has been pushed, would appear strange were it not for the low rate of wages which prevails. What machine tools were seen appeared to be built on the American lines of cheapness combined with strength sufficient for a few years, after which new and improved tools would be bought.

A neat magnet for holding iron castings on to a milling or planing machine was shown. It consisted of an electro-magnet, the poles of which were cut into the shape of teeth and almost touched one another, being kept apart by a strip of brass following the curve of the teeth. The work was subsequently demagnetised by an alternating current. A similar arrangement was seen in the form of a magnetic lathe chuck.

In one of the works the counter shafting driving lathes, &c., was all so fixed as to be readily movable along girders fixed to the ceiling, so that it could be moved to suit new machines as required.

(*f*) *Driving of Shops.*—The usual practice would appear to be to use direct-current motors for this purpose, though the A.E.G. employ three-phase motors throughout, even for cranes, where a torque of

2½ to three times the normal is said to be obtained at starting without an excessive current. Whether the load is rigidly coupled to the motor or is driven through a springy coupling could not be definitely ascertained.

Small induction motors have as a rule short-circuited rotors and wire resistances in the stator, while large motors are started by liquid resistances, usually in the rotor circuit. These resistances generally consist of lead plates dipping into iron vessels containing the electrolyte which forms the neutral point of the system. When right down three switch contacts short circuit the whole resistance. A solution of soda is the liquid most generally used. Although the more general practice seems to be to employ a separate motor for each machine, some prominent exceptions were noticed. The feature of the machine tools at the Dresden Railway repairing shops was the speed cones. One set of cones is mounted on an adjustable frame which can be screwed up nearer to the second cones when required, so as to leave the belt slack for changing. The drive is in this case only 2 to 3 ft.

As regards motor starting switches, there appears to be more metal employed than is usual either in this country or in America. Less attention is given to finish, but the whole construction seems more massive. In the case of one particular crane starter, the switch contacts consisted of blocks of carbon and copper pressed into a solid mass.

(*g*) *Miscellaneous.*—The drawings employed in the shops of one firm were inked and coloured and mounted upon thick mill-board about 4 ft. square. In most of the other works visited, unmounted blue prints, say, 3 ft. by 2 ft., were used. In one works neat celluloid cases were used, into which the drawings could be slipped and so kept clean.

The general impression gathered appears to be that everything looked as though it had been specially made for the particular purpose in view, and not simply built up out of materials at hand. In other words, nothing in the nature of a make-shift was to be observed.

Different works appeared to have had different objects in view, some seeming to strive after neatness and workmanlike finish, others after solidity, and others again after cheapness of manufacture. Throughout it was noticeable that less attention was given to minute details of heating and efficiency, such as often loom so large in our own specifications, but rather to general adaptability, price being considered at any rate as an important feature if not as the most important feature.

As regards fittings and wiring, the former appeared on the whole rather flimsy and "cheap," while the latter, though perhaps safe, was, as a rule, to say the least of it, unsightly, consisting as it did almost exclusively either of metal pipes, or of wires slung on porcelain insulators, the latter being often found even in private houses.

3.—Design, &c.

(*a*) *Switchboards.*—Nothing in the way of manufacture would appear to call for special notice, except, perhaps, the electrically or benzine-heated soldering irons used in some cases, the handle of the latter forming a reservoir for the benzine. Some small motor-driven portable drills were seen at work drilling marble slabs, the weight of the motor, which rested upon the slab, exerting sufficient pressure to press the drill home.

White marble slabs are almost exclusively used, the joints being either left exposed, or being covered up by half-round strips of brass fixed against them.

High-tension fittings were mounted upon porcelain insulators, and in the case of high-tension switches, which were usually fixed behind the board with insulated levers passing through to the front, very long breaks were allowed. That for 3,000 volts would be 10 to 15 in., and for 10,000 volts 20 to 30 in. as an average.

A heavy current fuse for 9,000 amperes at 220 volts was shown, which consisted of 8 or 10 "pressspahn" tubes, each with a copper wire passing through it, and all connected in parallel, the whole being contained in an outer protecting glass tube, 2½ in. in diameter. Some high-tension fuses were seen constructed on the same principle, only having glass tubes in place of "pressspahn." In this connection the so-called *Stoepsel* (plug) fuses should be mentioned. The fuse itself is mounted in a small round box fitted with an Edison screw cap, so that by merely screwing it into place, the fuse is inserted in circuit. Several ingenious methods are employed to render these fuses more interchangeable. The usual practice seemed to be to fix all switches, &c., in a room behind the board, while regulating resistances are placed in a cellar below the switchboard gallery.

As regards measuring instruments, the most noticeable feature was, perhaps, the want of originality in adapting them to modern requirements. Whilst in this country edgewise and illuminated dial instruments have been long used, nothing but round dials, 6 in. and 8 in. in diameter, were to be seen. A very large number of hot-wire ammeters and voltmeters were in use, but the general opinion appeared to be that now that satisfactory dead-beat instruments for alternating currents can be obtained, they will no longer be so extensively employed. The entire absence of all recording instruments was very noticeable. Most of the alternating-current boards were provided with round, direct-reading wattmeters—a practice which might well be copied in this country.

(*b*) *Direct Current Dynamos and Motors.*—Although the direct current dynamo occupies a place of comparatively small importance in Germany, it is evident that its design has received very careful study, and great uniformity, both as regards manufacture and design, is noticeable. Increase in diameter and reduction in armature length seems to be the general tendency at the present time.

Whilst it is impossible to go into detail, a few of the main points noticeable may be enumerated. With one exception, paper is used as the insulating material for armature core plates. Many laminated poles were met with, the laminations being about $\frac{1}{16}$ in. thick. The whole armature and commutator were always well ventilated, and usually a clear hole was left right through from end to end. Formers for small machines are usually made of some such material as pressspahn or stabilit, while for larger machines zinc is usually employed. Wood flanges are never used. One firm builds up its armature core plates and mills out the slots afterwards; if this is done dry there are said to be no evil effects due to eddy currents. Multipolar machines are almost universally series coupled, so as to avoid cross currents arising from unequal pole strengths. When heavy currents have to be carried, two or three series coupled windings are connected in parallel. With the exception of one firm, cast-steel is almost universally used in place of cast-iron except in very small sizes. Almost all the armature coils are wound upon frames ready for slipping into place, and the taping is done by a neat machine worked by a small motor.

(*c*) *Alternators and Alternating Current Motors.*—The methods of manufacture and design in the case of these machines appear to be much more tentative and experimental than is the case with direct current machines. Stationary external armatures are universal, while many magnets are wound with copper strip on edge left bare on the outer surface and insulated by "pressspahn" or some similar material. The winding of these coils is a matter of considerable difficulty, but if well done they have a neat appearance and the cooling surface is of course very effective. The armature windings are usually threaded through micanite tubes, extending in the case of high-tension machines some 2 or 3 in. at either end.

Leblanc "amortisseurs" are much used to improve parallel running, but the short-circuit pieces only extend through the width of a single pole and not from pole to pole as was at one time usual. The same effect is produced in some cases, though of course less efficiently, by the use of massive pole-pieces. As regards parallel running it may be remarked that it is most unusual to connect an unloaded machine on to the bus bars, an artificial load being still almost always used.

The tendency now appears to be to "wind" the rotors of even the smallest induction motors, and even when short-circuited rotors are used the "squirrel cage" is often replaced by a winding, in which the current has to pass through two or three turns in succession. In one firm at least a careful test is made by means of a lamp for contact between the core plates and the bolts holding them together.

The "A.E.G." have lately introduced a novel method of holding the armature plates of alternators; in place of the massive cast-iron or cast-steel frames into which the core plates are usually fixed, two rings, one at either side and bolted through, are employed. These carry the necessary feet for holding down the machine, and are strengthened by six or eight tie rods forming chords to the circle. This lightens the machine and gives a larger cooling surface to the core. A large three-phase machine of this type is running at the A.E.G. supply station, giving 1,000 kw. at 107 revolutions per minute. It is said that by unscrewing two of the tie rods, together with the clamps on the cast-iron rings, it is possible to lift off the top half without fear of springing. Further, as the machine gets hot the armature discs expand more than the tie rods, and the only effect is, therefore, to stiffen the whole structure.

In conclusion, the Committee records its thanks to its reporters: Messrs. L. Andrews, H. W. Clothier, C. Day, K. Edgcumbe, A. H. Foyster, H. A. Mavor, and P. W. Sankey.

Report of the Committee on Telegraphs and Telephones on the Visit of the Institution to Germany in 1901.

(*Read January 9th*, 1902.)

The members invited to report on telephones visited the Berlin Exchange, where a flat board is in use, arranged for 16,000 subscribers. This board is similar to that exhibited by Messrs. Siemens & Halske in the Paris Exhibition, and is divided into sections each about 6 ft. in length by 4 ft. wide, to which the whole of the 16,000 subscribers will finally be connected. Each section was in charge of six operators, and each operator attended to 100 subscribers.

The jack and indicator are combined, saving the space usually occupied by the separate indicator. The indicator consists of a white plunger, which becomes visible in the centre of the jack on the subscriber calling the exchange. This plunger is depressed out of sight by the insertion of a plug in the jack.

The multiple jacks used can be individually removed from the under-side of the board for cleaning or repairs, and easily reinserted by the use of a special tool, thus saving the necessity for removing the whole strip for repair to a single jack.

The rates of charge are as follows:—

Flat Rate.

M. 180 a year per line for conversations in Berlin and the following suburbs, called "Vororte":—Adlershof, Charlottenburg, Friedenau, Friedrichsburg, near Berlin, Neu-Weissensee, Nieder-Schöneweide, Mühlenbeck (Bez. Berlin), Pankow bei Berlin, Reinickendorf (Ost), Rixdorf, Rummelsburg bei Berlin, Templehof, Wilmersdorf bei Berlin.

M. 200 a year per line for conversations in Berlin in the "Vororte" and the following suburbs, called "Nachbarorte":—Cöpenick, Friedrichshagen, Gross-Lichterfelde, Grünau, Hoppegarten, Ludwigsfelde, Neuenhagen, Nowawes-Neuendorf, Oranienburg, Potsdam, Spandau, Steglitz, Tegel, Wannsee, Zehlendorf.

MEASURED SERVICE RATE, at 5 Pfg. each. (400 connections a year obligatory.)

M. 100 a year per line for Berlin and the suburbs called "Vororte."

M. ·05 extra for each connection to suburbs called "Nachbarorte."

COIN-IN-THE-SLOT MACHINES.

M. ·20 for three minutes in Berlin and the "Vororte."

M. ·25 for three minutes in Berlin and the "Nachbarorte."

About 25 per cent. of the present subscribers are on the toll rate and 75 per cent. on the flat rate.

It was stated that each operator can attend to from 100 to 160 subscribers on the flat rate, and the average number of calls per subscriber per day is given as about 16. On the toll rate each operator can attend to from 250 subscribers, and the average number of calls per subscriber per day is stated to be two.

In the larger towns nickel-in-the-slot telephone apparatus for the general public had been largely introduced.

As regards protection between traction overhead wires and telegraph and telephone wires, while guard wires were used in some places, guard nets seemed to be favoured in others. These had a wide mesh, perhaps 9 in. to 1 ft. In Hanover, on the other hand, some of the span wires for the trolley wire itself were attached to the iron telegraph posts.

The telephone service in Berlin is discontinued when thunderstorms are threatening.

STANDARDISATION OF ENGINES AND DYNAMOS.*

1. THE Committee on Standardisation of Engines and Dynamos has now completed its labours and has the pleasure to submit its final report, which it hopes will prove satisfactory to the Society.

Since our last report at Milwaukee, the Committee has continued its work on the same lines as hitherto, taking up carefully with manufacturers of engines and generators the points remaining to be standardised. We are glad to be able to repeat what we have said in previous reports, that the comments which have been received are almost without exception commendatory, and show not only a willingness to adopt the Committee's recommendations, but an appreciation of the work which has been done.

2. The Committee's investigation has covered the standardisation of the following points:—

(1) The standard sizes of units recommended.
(2) The corresponding revolutions per minute for these units.
(3) The sizes of shafts for the two classes of centre-crank and side-crank engines.
(4) The length along the shaft required for the generator.
(5) The height of axis or shaft over top of sub-base.
(6) The width of top of sub-base.
(7) Armature fit.
(8) Overload capacity of engines and generators.
(9) Brush holders.
(10) Holding-down bolts, keys, and outboard bearings.

SIZE OF UNITS.

3. Our endeavour has been to reduce the number of standard units to the fewest sizes. This will commend itself to all manufacturers as tending to reduce the great number of patterns required to be kept on hand. For reasons stated in our report to the Milwaukee meeting, the largest size embraced in our list is 200-KW. capacity.

In this connection our report only covers the standardisation of direct current generators.

REVOLUTIONS.

4. These standard speeds have been chosen after careful deliberation and investigation of the practice of all the engine and generator builders in the country. It will be observed that we have provided for a permissible variation of speed of 5 per cent. above or below the mean speed, which we recommend; an examination of the practice of all the engine and generator builders shows that this covers practically all the machines which may be considered as a standard make at the present time, and we have been assured by some builders whose conditions differ somewhat that if there is a general agreement upon the scheme outlined, they will be prepared to change their machinery to conform to the recommendations.

SHAFT DIAMETERS.

5. These are also the result of careful analysis of the existing practice of all manufacturers and a consideration of all the conditions affecting the diameter of the shaft. The preliminary report which we sent out to the manufacturers has elicited only a few adverse criticisms, and these, after correspondence, were withdrawn.

In order that the reason for the diameters of shafts that we have recommended shall be thoroughly understood, we may explain that (especially in shafts for side-crank engines) the permissible deflection has determined the diameter. This, in some cases, is larger than would have been necessary for torsion and bending where deflection did not have to be considered.

As cases sometimes arise where cross-compound engines or double engines are connected to generators coming within our recommendation, and as such units require considerably larger shafts than those given in our tables, we deem it necessary to state, specifically, that our recommendations apply only to engines of usual proportions, with the generator attached at the side of, instead of between, the cranks.

LENGTH OF GENERATOR ALONG THE SHAFT.

6. When we came to investigate the question of length along the shaft (between limit lines) to be provided for the generators, we found that the practice of manufacturers required provision for two classes, which may be called "long" and "short" generators.

It would, of course, have been much better if we could have provided for but a single class, with a small allowance for variation, but there is such a marked difference in the lengths for the same power that we have deemed it best to make provision for these two classes, so that the engine builders can govern themselves accordingly. It will be noticed that the maximum difference in lengths between the two classes is 6 in., which in the small sizes is reduced to 5 in.

In the case where an engine is to be provided for a generator which falls into the "long" class, but which is only a little over the limit for the "short" class, or one which is considerably less than the maximum of the "short" class, the excess clearance is to be provided for on the side next to the engine; that is to say, the side away from the commutator.

We have carefully considered the fact that for these varying lengths of generator and shaft the engine builder has to provide different lengths of sub-base, and in order to reduce the expense of patterns here to a minimum, our idea is that these patterns would be made so that the end away from the commutator can be extended the necessary amount, 5 or 6 in., to take care of the increased length of bed. Obviously, this means simply a standard pattern with a standard adjustable end for each unit.

HEIGHT OF SHAFT.

7. As is well known, there are two classes of generators to be provided for under this head: Those which are split vertically, and those which are split horizontally. The former have a flat base which rests directly upon the flat top of the sub-base, while the latter have feet which take the weight of the generator.

In order to arrange that the engine builders' patterns may be reduced to a minimum and still may be stock patterns, which will fit every style of machine, we have chosen dimensions for height of axis of shaft above top of sub-base sufficient to allow for the vertically-split machines, and also, except as stated later, to clear the periphery of the horizontally-split machines.

As will be seen, the scheme provides for a main pattern to which patterns for the stools and seatings for both horizontally and vertically-split generators can be attached before the pattern is sent to the foundry—stools for the horizontally-split machines and rectangular seatings for the vertically-split machines.

In the case of the 150 and 200-KW. units, we have provided for a recess in the top of sub-base to allow the lower part of some horizontally-split generator frames to be accommodated, and so to avoid unduly raising the centre of the shaft. In the case of the vertically-split machines and those which are split horizontally and do not need this recess, the top of the sub-base will be flat and continuous.

WIDTH OF TOP OF SUB-BASE.

8. This has been decided by careful examination of existing practice, and we believe that the figures we have recommended will cover the necessities for all sizes of generators.

ARMATURE FIT.

9. The matter of armature fit has received very careful consideration from the committee, and our recommendation is for what is known as a single fit.

We have obtained the opinions of manufacturers in respect to the allowance to be made for a pressed fit, and find that allowances of $\frac{1}{1000}$ in. for shafts 4 in. to 6 in., inclusive, and $\frac{2}{1000}$ in. for shafts 6½ in. to 11 in., inclusive, represent the best existing practice.

The armature bore is to be the *exact* size given in the table, and the allowance is to be made by the increase of diameter of engine shaft.

We believe that in order to secure the best results, it will be necessary to work to a definite gauge; to this end we recommend that the generator builder furnish a gauge the *exact* diameter of the bore and the engine builder make the necessary allowance for the pressed fit, as recommended. This will avoid uncertainty as to the responsibility for the fit.

OVERLOAD CAPACITY OF ENGINES AND GENERATORS.

10. All the features of our recommendation have so far had to do with the question of dimensions as affected by the mutual relations of the generator and the engine. An important point, however, which affects both the generator and the engine, is that of the overload capacity which can reasonably be expected. As is doubtless well known, generator builders are frequently called upon to provide, during short periods, for overloads of as much as 50 per cent., and in occasional cases of even 100 per cent.

It is evident to every engine builder that to provide an engine large enough to drive the generator under such extreme overload capacities, gives an unreasonably large engine for the rated load, and seriously interferes with the economy with which the power is produced.

Bearing in mind that our recommendations are entirely for tandard practice, we are led to recommend that the standard over-

* Final report of Committee presented at the New York meeting (December, 1901) of the American Society of Mechanical Engineers.

load rating of any direct-connected unit should not in any case exceed 25 per cent. of the rated capacity.

It will, of course, be understood that under these conditions of overload the economy of the unit should not be expected to be as high as when operated at the rated load. We have also been asked by some engine builders to call attention to the importance of giving the unit special attention when it is so operated.

If, under peculiar conditions, a higher overload capacity is demanded, it must be understood that this is a special case not covered by the standard machines, and provision must accordingly be made for meeting this demand.

Brush Holders.

11. We recommend what we believe is now the practice of the best generator builders, that the brush-holder rigging shall be supported upon the generator frame. This, we think, will commend itself, as it makes the electrical part of the outfit entirely self-contained.

(To be continued.)

CURRENT SPECIFICATIONS.

LXXXIX.—LLANDUDNO ELECTRIC LIGHTING AND TRAMWAYS.

Summary.

Extent of Contract.—Supply and erection upon prepared foundations of two 150-kw. steam dynamos.

Type of Engines.—To be of two-crank vertical high speed type.

Speed.—Not to exceed 350 revolutions per minute.

Steam Pressure.—140 lbs. per sq. in. at stop valve when engines working either condensing or non-condensing.

Output of Dynamos.—Normal load 150 kw., each machine to be capable of taking an overload of 25 per cent. for short periods without undue heating or any sparking at the brushes.

Voltage and Winding.—As shunt machines, to give full output of 100 kw. at any voltage between 460 and 500 volts.

As compound machines, to give 500 volts at no load and 550 volts when a current of 275 amperes is flowing.

Temperature Rise.—Not to exceed 70° F. above surrounding atmosphere after 12 hours' run at normal full load.

Parallel Working.—Successful parallel running when working as compound machines must be guaranteed.

Commutator.—To have a radial depth of wearing of not less than 1 in.

Current Density in Carbon Brushes.—Not to exceed 35 amperes per sq. in. when machine is working at 25 per cent. overload.

Guarantees.—Steam consumption and efficiency guarantees to be stated in tender.

Specified Date of Completion.—First set by June 14th, 1902; second set by July 26th, 1902.

Penalty for Late Completion.—One per cent. per week on the total contract price, equal to 2 per cent. per week on the contract price per set.

Terms of Payment.—*Fifty per cent.* on delivery, further *forty per cent.* on completion, *ten per cent.* at end of six months' period of maintenance.

Stipulations as to Removal of Foreman.—Stringent. See comments.

Stipulations as to Wages to be paid to Workmen.—Satisfactory.

Arbitration Proposals.—Stringent. See comments.

Date for Receipt of Tender.—February 3rd, 1902.

This specification has been prepared by Mr. Harold Morton, the electrical engineer to the Llandudno Town Council.

Its provisions are on the whole of an acceptable character, and we have little but commendation for the manner in which the technical parts have been prepared. The arrangement of the paragraphs might be improved, but there is no attempt to unduly limit the discretion or responsibility of the tenderer.

Guarantees are to be given by tenderers, and tests will be taken at the engine makers' works before delivery to verify the figures given in the tender.

It would be more in accord with modern practice if the penalty for late completion were calculated on the contract price per set; in its present form there is no difference whether one or both sets are late, and if only one set be behind time the penalty works out as 2 per cent. per week upon the contract price of that set.

Tenderers should carefully note the well-defined liabilities of the contractor, especially as regards accuracy of drawings and sufficiency of foundations.

Standard rates of wages are to be paid and usual hours of labour observed. In our opinion the powers claimed by the engineer in the matter of his employing workmen at the expense of the contractor are too extensive, and should be modified in the final contract.

In the same manner the arbitration clause should be unlimited in its operation; at present nearly all possible causes of differences of opinion are excluded from its operation. It is a point we are often called upon to urge on young consultants, that if a specification is properly drawn up there is nothing to fear from an unlimited arbitration clause. Our leading consulting engineers set a good example in this respect; almost without exception they are willing to submit to independent arbitration any dispute arising out of their contracts, and we wish that their practice were more frequently followed by younger men.

THE RECENT STREET ELECTRIC EXPLOSIONS IN THE CITY.

Board of Trade Inquiry.

On Wednesday, at the Guildhall, Mr. A. P. Trotter, of the Board of Trade, opened an inquiry into the explosions which occurred on January 4th and 5th in the City in connection with the electric light. Sir H. Crawford, the City solicitor, represented the City Corporation; Mr. Roskill, the City of London Electric Lighting Company; and Mr. Wilmot Seale (secretary of the Charing Cross and Strand Electricity Supply Company), represented his company.

The inquiry was held in the Old Council Chamber, and the evidence took such a conversational turn between the Board of Trade inspector and the witnesses, that it was impossible for the press, who were located behind the parties, to follow the proceedings at some points.

Police-Constable Ware was the first witness called, and stated that being on duty at Newgate Street on January 4th, his attention was drawn to smoke issuing from a manhole opposite Giltspur Street, Holborn Viaduct. An employé of the Charing Cross and Strand Company went down, and was overcome by the smoke. Subsequently, a gentleman named Smith, who said he was an engineer of the Charing Cross and Strand Company, came, and stated that the wires had been fused and caused the accident.

Police-Constable Neal deposed to seeing smoke coming from three chambers in Newgate Street. One belonged to the Charing Cross and Strand Company, and two to the City of London Company. There was nothing said by the employés of the Charing Cross Company at the time about a match being lighted.

A boy named Goole, who was injured by the explosion which took place in one of the Newgate Street boxes, said he noticed a man go down the hole with a lantern, and immediately the explosion occurred.

Police-Constable Hutton, on duty in the neighbourhood, saw three explosions in Newgate Street, the second explosion occurred three minutes after the first, and the third a minute after the second.

Mr. W. H. Patchell, the chief engineer of the company, stated that the Charing Cross and Strand Company had powers entrusted to them under the City Electric Lighting Order, and proceeded to describe the system adopted by the company. They supplied direct current on three wires with 200 volts, and the network was complete in that portion of the City where the explosions occurred. They worked with a constant earth test, and the indicators were never off. On the Friday preceding the explosion there was some earth leakage, and they were trying to find where it was. They worked at this on the Saturday, and at one o'clock on that day the engineer-in-charge thought there was nothing in it, and stopped disconnecting. The engineer, Mr. Harpham, left instructions to have other disconnections made, in readiness for his coming back at ten o'clock on Monday morning. About 1.20 they saw a sudden load come on, and he was telephoned for. Mr. Harpham began to disconnect, and sent men to the Giltspur Street box; one of the men tried to get into the box, and was overcome. Then they got information from a customer at King Edward Street, that smoke was coming into his cellar, and they sent to disconnect there; they found that the distributor had burned 2 ft., and the feeder was burned below the distributor, but the cables below were not injured. The jointer went into the King Edward Street box with a lantern, and an explosion occurred. Ten minutes afterwards another man went into the box again and struck a match, and there was another fire. The man got out, and as he was doing so, he saw the lid of the box of the City of London Company go up. That was the only other box he had heard of until the policeman mentioned another that morning. Witness produced a number of plans showing the position of the boxes in Newgate Street. There was nothing to show that the explosion in the City of London Company's box was due to the explosion in his company's box, and he saw no electrical connection between their burn-out and the simultaneous burn-out of the City of London Company. So far as he knew, there was no connection between the two.

Witness was cross-examined at considerable length by Sir H. Crawford, and said this was not the only explosion they had had. They had had two in Paternoster Row, and the reason assigned was, that the connectors came in contact. It was true that the Corporation had communicated with his company as to the inspection of boxes, and the reply sent was, that it was not necessary to make a fixed rule as to inspection. Some of their boxes were inspected fortnightly, some monthly, and in some cases it was only necessary to inspect every two months. What led them to inspect the box at Giltspur Street was, that they went there to disconnect. If they got an earth in the district they broke the network into smaller sections and tested each section. That was what they were doing on the day of the explosion. At 1 o'clock on the Saturday the engineer thought that all that was necessary had been done, and knocked off work. But for the coincidence of the load coming about a quarter past one, there would have been no one engaged in street work. They knew there was something wrong then. If he had been there he would probably have taken down a lantern the

same as the workman did. He accounted for the explosion and the smoke by the inflammable vapour given off by the bitumen. He did not think it was a wise thing for a man to light a match after the first explosion. He could not say whether the explosion in the City Company's box was due to the explosion in his company's box.

The City Solicitor: As the result of your investigation, you think no better system could be followed by your company for the safety of the public with regard to the insulation of cables?—I do not think so.

Or with regard to the use of bitumen?—I do not think so. The only thing is, in the case of a short, to keep the bitumen gas in the immediate neighbourhood of the place where it is given off.

With regard to the inspection, are you prepared to undertake to inspect more frequently in the City?—We have men going round constantly, and I do not think any inspection would have shown this. The box where this occurred could not have been inspected, as you would have to dig it out.

Did you know that your engineer thought it was likely there would be an upheaving of the streets, and asked the police to take the necessary steps?—I was not aware of that.

In cross-examination by Mr. Roskill, Witness said the system adopted by his company was the solid system, which was a dearer system than the draw-in system. He did not think there could be two opinions about that in the minds of those who understood the question. In the solid system the cables were buried, and therefore they had to anticipate their future requirements. Their system was not altogether solid, as they had spare ways for future requirements. The cables were put into a box and bituminous matter was poured over them to fill the boxes.

You have said that one box was completely burned out and no bituminous matter left. The inference is that the whole of it became vapour?—The volatile matter.

Is it not reasonable to presume that wherever there is a leak you are likely to meet with similar accidents owing to the system adopted?—Yes and no; if things were left exactly as they are, yes. It shows we must cut the district into smaller areas than at present.

Continuing, Witness said they did not use any fuses in their boxes; they took up a great deal of room, and were a source of danger. Of course, the suggestion made was that the bituminous gas went from their system to the City system, but he did not admit that.

Mr. Roskill: If there is a crack in the ground underneath you, how do you propose to prevent the gas entering our system?—If the vapour gets into your boxes, there must be something wrong in your box to enable it to get in.

In re-examination by Mr. Seale, Witness said the solid system was approved by the Board of Trade. All the inspection in the world would not have discovered what took place, as it was gas generated at the moment which exploded when the lantern was taken into the box.

Mr. Roskill: Does the question of inspection apply in equal force to a system which is only partly solid?—When you have a draw-in system you have to inspect more frequently.

Mr. Trotter: If you have spare ways, you might transmit coal gas; therefore, it appears that you want as much ventilation and inspection?—Yes.

Have you ever known an explosion before from bituminous matter?—No.

Is it, as far as you are aware, the first explosion which has taken place with the solid system with bitumen?—Yes.

Several workmen, and Mr. Harpham, engineer, were called and examined in reference to the Newgate Street explosions, and the last witness endorsed the views of Mr. Patchell.

Police evidence was then called with regard to the second explosion, which occurred in Ludgate Hill on Sunday, January 5th. It was stated that flame came from the box of the City of London Electric Light Company there for 40 minutes, the fire being eventually subdued by means of sand by the Metropolitan Fire Brigade.

Mr. Frank Bailey, the chief engineer of the City of London Electric Lighting Company, first dealing with the Newgate Street explosion, said that the distributing main of his company was uncovered on the Monday following the explosion, and a section was cut out and was now at their office. They found that the bituminous casing showed distinct signs of having been heated, and they had, therefore, conclusive proof that the cause of the fire was external, either due to the temperature of the surrounding soil or to a direct flame issuing from the subsoil. He thought that if there was a fissure in the soil between the box of the Strand Company and the box of his company the vapour would come along, and if it got into their box there would probably be sufficient oxygen to cause an explosion. That was the only thing to which he could attribute that accident. With regard to the Ludgate Hill explosion, he believed it was due to the metallic covering of his cables having to carry an excessive leakage current produced by another company, who did not take sufficient precautions to guard their cables. The reason why the explosion did not take place till later was that the day was exceedingly wet, and moisture got into the box. He thought the Charing Cross Company ought to provide metallic covers and should more frequently inspect their boxes.

In answer to Mr. Seale, Witness said his point was that the Charing Cross Company was producing dangerous earth currents, and his company was getting rid of them at great cost. He agreed that the solid system would be the best if it were properly carried out, but it was not the best as done by the Charing Cross Company.

By Sir H. Crawford: He considered that his company's system was better than the system as carried out by the Charing Cross Company.

Mr. J. P. Buck, superintendent of the mains of the City of London Company, gave evidence as to a number of cases in which the Strand Company had injured the mains of the City Company, and Mr. Wordingham, of Manchester, was called, and stated that while he did not think it possible to have a true explosion on the solid system, it was possible to have a burn out. He thought it was very difficult to trace any connection between the explosion which took place in Newgate Street and the one which occurred 12 hours later in Ludgate Hill.

The inquiry then closed, and Mr. Trotter said he would report to the Board of Trade.

THE LONDON ELECTRICAL CONTRACTORS' ASSOCIATION.

On Monday afternoon a company of close upon 100 gentlemen representing electrical manufacturers and contractors, met at Anderton's Hotel, Fleet Street, E.C., for the purpose of talking over together numerous grievances under which contracting firms labour. Mr. H. M. Paisley, who was described as an impartial solicitor not connected with the electrical trade, was voted to the chair, and Mr. E. J. Hogan, the hon. secretary, then read out letters received from 20 manufacturing houses in reply to one sent out for the purpose of ascertaining their views in regard to the existing difficulties. These letters, for the most part, approved of the principle of the Association, but many of the firms withheld from actual membership until they knew the names of other manufacturers who were joining the movement. Mr. W. R. Woodward, the president of the L.E.C.A., addressed the meeting, opening the ball, so to speak, for a general discussion. Merely for purposes of debate, he moved the following resolution:—"That this meeting of manufacturers, supply houses, and contractors, considers that the best interests of the electrical trade will be served by manufacturers and supply houses adopting the principle of allowing no one outside the recognised electrical trade a greater percentage of discount than . . . . of the trade discount, and that the electrical trades shall mean any house carrying on business as such, or that has a department under the superintendence of a duly qualified man." This resolution was seconded by Mr. C. L. Troup, and considerable discussion ensued. Mr. Simon (Simon, Berry and Co.), said that it was necessary for it to be defined what the words "electrical trades" were to mean before they could come to a satisfactory conclusion. What would they consider railways, docks, mines, mills and such like? Mr. Woodward said that dock companies would never come to the contractor. Mr. Bevis (of the General Electric Company, Limited) asked whether they were talking about fittings only, or about the whole electrical business? What about medical electrical apparatus in which contractors present did nothing? The London Dock Companies had a large contract every year for carbons. As it was they could only hold their own, and as often as not the order went abroad. If they only gave a reduced discount they would simply lose the order, and the German agent would run away with the whole business. He took exception to a remark from Mr. Troup that dock orders were bound to come direct to the manufacturers. German agents supplied contractors at the same prices as they supplied other people. He said that 50 per cent. at least of the electrical contractors bought from the German agents. Mr. Oppenheimer said that the resolution could not be adopted until it had been thoroughly threshed out. There were points on which he was in agreement with contractors, but how were they to scrutinise between the shipper and the contractor. Mr. Woodward said that what they objected to was that manufacturers took orders from shippers and delivered, say, to Brondesbury. A shipping order delivered to export packers was all right. The next speaker, a north-country contractor, thought that suppliers could diminish the discount to steel works, mills, and so forth gradually, and give the full reduction to the legitimate trade only. The manufacturer and merchant, to all intents and purposes, were one. As to the bogey of foreign competition, contractors did not want to go to Germany for material. They would use English material in every case, because it was better at the same price, if only suppliers would allow them. Another contractor referred to the position of architects who obtained full trade discounts from suppliers. There was here a distinct tendency to introduce into the discussion personal remarks regarding certain firms, but, happily, an end was put to this by a protest offered by Mr. Rawlings, and largely supported by the meeting. A question was asked as to how Mr. Woodward would deal with ironmongers, and the reply given was "If you have a department under the charge of a qualified man, you are an electrical engineer, and should be entitled to all the privileges that we receive." Mr. Justus Eck, of the Union Electric Company, referred to the point as to how they were to deal with municipalities. He had been an electrical engineer to a contractor for 10 years, and had had great difficulty in finding his bread and butter. Many a time had he gone to place a "fitting" order, and found that the architect or consulting engineer was given 5 per cent. for cash, but never any trade discount. Mr. Rawlings said that, as member of a municipal body, he frequently saw invoices which showed him that municipal bodies sometimes got better terms than he took himself as a contractor. He said some hard things about consulting engineers and trade discounts. A consulting engineer was not a trader, and he would be insulted if they called him one. Mr. Douglas Bate (Stewart Electrical Syndicate) said that his personal difficulty

was that the contractor would not support suppliers in any way. He (the contractor) would buy in the cheapest market. He had again and again drawn attention in the electrical press to the fact that there were firms of wholesalers and installation engineers who had entered into an alliance one with the other—one half to be a contracting firm, and the other half a wholesale house. Such firms were supported, but suppliers were not supported in the way that they should be. Could they not get the trade to agree together that they would not act one day as consulting engineers, the next as manufacturers, and the third as agents? The contractors had it in their power to do it. He had received letters from consulting engineers asking trade discounts. He had always replied that they are given to the trade only, and had asked them for their "trade card." If they, as suppliers, were supported, they would support the contractors, but if not, the contractors could not expect them to put themselves out one inch to help them.

Mr. Woodward withdrew his resolution, and one for the appointment of a joint committee from both sides was placed before the meeting. On this point Mr. Bevis said that in the U.S. they were experts in forming such associations. They had a manufacturers' combination, and that helped the contractor, because they had recognised prices beyond which they could not go. That was the crux of the whole thing. It was no good a few of them combining if a little man came in, and ran through those prices. They had an association there of supply houses. Houses which wanted to join the association had to put up $1,000 as a deposit. Once a month they met to fix prices, and also to appoint a detective. Nobody knew who that detective was to be for the month until the sealed envelope was given out, and the selected man was then empowered to go round and try if people were loyally keeping to their contracts. If he was not, then at the next meeting he was found out and paid a monetary penalty. One house was mulcted in $400. Lavish talk notwithstanding, he believed in deeds. If the trade did not support them were they to fold their arms and see the trade supporting other people? They only asked to be protected. To protect their interests must be mutual.

A committee was then appointed as follows:—*Contractors*, Messrs. Woodward, Phipps, Duncan, Troup, Glover and Marryat; *manufacturers*, Messrs. Bevis, Bate, Eck, Grainger, Northcote, Simon and Oppenheimer.

Mr. Hogan was appointed secretary to the committee, and the meeting closed with a vote of thanks to the chairman.

Contractors or manufacturers requiring information regarding the Association should apply to Mr. Hogan, at 141, Fenchurch Street, E.C.

THE THERAPEUTIC ACTION OF THE BLUE ELECTRIC LIGHT.*

By Dr. A. W. MININ, St. Petersburg, Senior Medical Officer of the Imperial Bodyguard Cavalry Regiment.

Notwithstanding the fact that to-day scarcely anyone doubts the energetic therapeutic action of the blue electric light, still I consider it may be useful to mention a few cases which, thanks to that treatment, have undergone a mild course and had a very rapid recovery. The undoubted superiority which belongs to the blue electric light principally depends upon its action upon the vasomotor nerves. The action of heat is precluded on the ground that the blue electric light is more active at a certain distance than in close proximity. The effect of the blue electric light is the reverse of that of the white. The difference will appear in what is to follow. I would now only point out that a granulating surface will become anæmic under the influence of the blue light and hyperæmic under that of white light.

The degree of pain-allaying power possessed by the blue electric light is far greater than I have hitherto observed. Although I had often been astonished at the alleviation brought about so quickly by the blue electric light in acute pleurisies, still I had only used it for making a tender spot tolerant to investigation, but now my experience has shown that far stronger claims may be made for its efficacy in this respect. Now we resort to these rays instead of cocainisation to render incisions and stitching of wounds painless, and the blue electric rays not only cause a more complete anæsthesia, but powerfully promote the healing from the very beginning.

As examples I may relate my experience in two cases with persons of widely different social position and education.

1. Mr. X., secretary of a foreign embassy, cut his finger with a piece of glass. The cut was on the outer side of the third finger and about 3 cm. long. After a 10 minutes' radiation with blue electric light from a small lamp of 50-c.p., two stitches were made without any pain. Healing commenced at once and was completed in four days.

2. A soldier of the Bodyguard Cavalry Regiment cut the dorsal surface of his left thumb, the wound being about 3 cm. in length. After cleansing and a 10 minutes' radiation three stitches were introduced, and also in this case the patient felt no pain. He chatted the whole time with someone present, and thought "a soft cotton ball was pressed on to the wound." On the third day healing had occurred by the first intention.

These two cases place beyond doubt the fact that stitches may be introduced and removed without pain, under the influence of the blue electric light.

* *Journal of Physical Therapeutics.*

ENGINES AND BATTERIES FOR POWER STATIONS.

By an Engineer.

The gas engine of accepted best type—that which works on the Beau de Rochas cycle—is of necessity compelled to make three idle strokes for one working stroke. The one working stroke must therefore produce the energy that is necessary for the three idle strokes, as well as for its own friction and all external work also. Obviously, therefore, there must be a large difference between the indicated and the brake horse-power of a gas engine. It is this fact that makes the gas consumption so large at powers less than a maximum. If the mechanical efficiency or $\frac{\text{B.H.P.}}{\text{I.H.P.}} = 80$ per cent., then must each working stroke give up one-fifth of its power to overcome friction. Assuming that an engine at full load indicates 100 H.P., and gives off 80 H.P., how many per cent. of the same number of explosions will yield 40 B.H.P., *i.e.*, half power? The engine friction will still be the same, and there must be still 20 H.P. of difference between the B.H.P. and the I.H.P. The latter must be 60. In other words, to secure half the effect, there must be employed six-tenths the total power. Where 25 cb. ft. of gas had produced 1 B.H.P., there would now probably be required 30 cb. ft. per B.H.P. when half loaded. This is on the assumption of the same consumption per I.H.P. at all powers, which is probably too favourable.

The wastefulness of gas engines at low powers has always been recognised, but, curiously enough, though possibly the steam engine is fully as wasteful, it does not appear to have been so recognised. That this is so, is amply proved by the illogical tests that are demanded from steam engines. Lengthy tests at full load are asked for, and the results are even made to serve for the purpose of giving a bonus to the contractor. Never again does that engine run even five minutes at full load, or even at a steady load, and the tests are useless as regards economy. It would seem to be sounder testing practice to demand proof by indicator diagram that the engine was in good order, to ask for a static test of steam tightness, and other matters. It would show the capacity of the plant, and develop any particular hidden or unsuspected weakness to put it through a series of instantaneous load variations from 0 to 125 per cent., especially if the fly-wheel is placed, as it is sometimes, at the wrong end of the crankshaft.

With a gas engine there is a difficulty that does not occur with steam engines. A steam engine will continue to work at a rate much higher than its most economical rate. There is no such limit in the gas engine. The full rate is the most economical possible rate. When loaded beyond this, the engine begins at once to slow down, and will soon stop if the overload is not taken off. By means of a very heavy fly-wheel a gas engine may be made to carry a heavy overload if of short duration, but such a fly-wheel, of course, implies a constant addition to the running friction, and must be paid for in meal or malt. But unless this waste is faced the gas engine, if called on to drive a variable load, must be run mainly at part load, or much below its full load, and it must, like the steam engine, be correspondingly wasteful. Being so essentially an engine to run at a steady load, the gas engine should be supplemented by a storage battery. Thoroughly satisfactory means have now been introduced for working the prime mover at a constant rate and making good its deficiency or storing its surplus by means of accumulator batteries. Mr. Highfield, of St. Helens, has added notably to our knowledge of this subject, and there can be no doubt in the minds of engineers who have grasped the nature of the losses of the steam or gas engine that the accumulator is deserving of every attention, and that there is a great future for it when thoroughly well made and attended. Accumulators have not always been well attended, and they have suffered unmerited blame in consequence.

In traction work the habits and experience of electric light engineers have been allowed far too much weight. Particularly is this so in respect of the item of voltage. However essential in lighting, an absolutely even voltage in

traction work is of far less importance. With compound-wound generators of the usual railway type the voltage is made to increase with the output, and this very fact will render a battery incapable of discharging against such a pressure into the line. So arranged a battery will produce but little effect on the engine load.

If, however, a shunt generator be employed with a falling characteristic of sufficient range and be worked in conjunction with a battery of liberal proportions, the battery will work in parallel with the generator and take up load when this passes the mean load or it will absorb current at low loads. The writer can hardly agree with Mr. Grindle's condemnation in a recent issue of the Electrical Review of the simple system of booster advocated in a previous issue. There are so many arrangements of boosters to help a battery to charge or discharge, that engineers cannot be expected to cling fast to the one which alone seems to meet Mr. Grindle's special views. The one important fact to keep in mind is to avoid stressing a battery too heavily and to aim at running the engine, whether it be a steam or a gas engine, at a constant rate. This is more especially desirable for gas engines. Though so much superior to steam engines in thermo-dynamic efficiency, gas engines are far from perfect as machines, and this it is that makes them fall off in their output efficiency so seriously when underloaded.

The possibilities of gas are only just being appreciated, and cheap gas is likely to be produced in large quantities. The ironmasters also may some day wake up from their long sleep and decide to utilise the furnace products they now throw away. The disadvantage of the poor gases is their heavy content of nitrogen, so that an engine will hardly produce more than 80 per cent. of its power when worked with poor gas, that is to say, 80 per cent. of the power that would be given by an ordinary town gas. Hence the importance, with poor gas, of keeping a full load on the engine.

Turning now to the battery, there appear to be certain advantages in placing it at a sub-station. The position of the sub-station will depend upon the magnitude of the system, and on the load factor of the system or of the particular line or feeder on which the battery is placed.

The maximum output of the battery is the surplus of the maximum above the mean load. On a small system the battery output will be much greater for short periods than the station output, and the divisions into which the battery sub-station divides the line will correspond with the ratio of battery output to station output. For example, with a load factor of one-third, the battery output at a maximum will be two-thirds, and the battery would be placed so as to divide the line into sections having a ratio of 2 : 1, the longer section being between power house and sub-station, or approximately so. Then, at times of maximum load, one-third the current goes from the battery outwards towards the extremity of the line, one-third goes from the battery towards the station, and the remaining third goes from the station towards the battery.

With less load factor, the battery will be proportionally further from the station.

(*To be continued.*)

THE CONVERSION OF OUR RAILWAYS.

In a letter that appeared last week in one of our contemporaries, Mr. Langdon, president of the I.E.E., stated *that it was to the main lines he looked for the greatest success in the application of electrical power.* Now it is needless to say that we do not wish to stand in the way of progress, but at the same time we believe that premature action has done great harm in the past. We need only point to the failure of Brunel's *Great Eastern*, which put back the building of large steamships for many years. It is unwise to attempt to develop a new idea under conditions where experiment is so costly, and the slightest error may involve the throwing back of the system for an indefinite period.

A more recent example of this principle was the case of the London Electric Supply Company, which undertook to put in units of power of excessive size, and to transmit the current at pressures which had been unheard of until then, although now quite common. The result was financial failure. A later instance of the same thing has happened in Paris, where miles of electric tramways on the surface-contact system were put down, which will probably have to be taken out and replaced either by the overhead or the conduit system.

We regret that Mr. Langdon did not urge more forcibly the needs of the present, instead of, like Mr. H. G. Wells, speculating on the probabilities of the future. That there is a field for electric traction on our railways, has frequently been pointed out by ourselves and by Mr. Philip Dawson in the columns of the Electrical Review. The electrification of our suburban lines presents no uncertainties, a fact of which all those who have had practical experience in traction work are aware. This is far from being the case as regards the application of electrical power to our main lines. We should certainly look forward to the latter, and doubtless the experience gained by the transformation of our suburban lines will stand us in good stead when we come to deal with long-distance traffic, just as the experience gained on electric tramways has enabled us to cope successfully with the requirements of the heavy traffic that obtains on suburban lines.

In this connection we would quote from a paper read by Mr. Edward C. Boynton on February 28th, 1900, before the American Institute of Electrical Engineers :—

"In certain densely populated manufacturing States, where there is a city larger than any other within 50 miles radius, and within that radius are several towns and small cities not over 20 or 30 miles from the larger city . . . . suppose that electricity be substituted for steam in that section, and a train service consisting of two or three-car trains running every half-hour from each end be instituted, with a *maximum* speed of 50 to 60 miles per hour, and the fare reduced to 1 cent per mile. There is no doubt in the minds of those who have watched the development of such cases, that the increase in traffic and low operating expenses would result in a far greater profit than was ever before earned by that section of the road. It is well known that such conditions exist on our steam railroads in many localities. . . . . It should be fully understood that no steam railroad will equip any portion of its line, except with the provision that nothing shall be done that will prevent the running of steam and electric trains over the same track. . . . . *It is unlikely that any steam road will equip a portion of its main trunk line until it has satisfied itself as to financial results by giving it a thorough trial elsewhere.* . . . . In considering a train service consisting of heavy trains running at the speeds mentioned, the trolley wire, as a working conductor, will probably not come into general use."

In the discussion which followed, Mr. F. J. Sprague said: "When trains are operated in large units with comparatively few units between terminal points, and these at considerable intervals, the steam locomotive will absolutely hold its own. Electricity will take the place of steam locomotives for railway service only in part, and then only when the number of units operated between the terminal points is so large that the resulting economy will pay a reasonable interest on the combined cost of central station, conductors, and the motor equipment, and the traffic existing is commensurate with the needs of such a system."

Mr. Langdon does not seem sufficiently impressed with the imperative necessity of at once electrifying the suburban lines of our railways in large towns like London, Liverpool, Manchester, and Glasgow, if they wish to retain the suburban traffic, which is in great danger of being taken away by the electric tramways and light railways which are everywhere springing up.

As we pointed out in a leader on Mr. Langdon's paper before the Institution of Electrical Engineers, in November, 1900, that he does not appear to have made a serious attempt to work out in detail a complete solution of a practical case, but only to have considered approximations, which are very liable to lead to false conclusions.

Mr. Sprague said at the time that he did not think it was safe to predict that the electric locomotive would universally take the place of the steam locomotive.

In the presidential address to the Institution of Electrical Engineers last year, Mr. Langdon again still harped on the subject of the electrification of our *main* lines. He advo-

cated that, with the exception of express trains, both passenger and goods trains should move at the same speed. It would appear as if the increase in speed of heavy goods trains would do much to counteract the saving which Mr. Langdon thinks would be effected by the introduction of electricity on our main line railways. It is possible that in the future it may be advisable to run our main lines electrically, but that time has not yet come. If Mr. Langdon is anxious to bring it nearer, we think he would have been wiser had he concentrated his attention, and dwelt at greater length on the absolute necessity of electrifying at once our suburban lines, and on the great advantages to be obtained therefrom. By this means not only would they keep their traffic, but they would probably greatly increase their receipts whilst decreasing their operating expenses. The capital expenditure involved by such a change would be fairly heavy, but we firmly believe that the saving effected would more than compensate for the extra money spent. Our knowledge at the present time is such that the cost of installation and operation can be accurately foretold, and there is nothing experimental to involve the risk of loss of capital.

The problem of running high speed long-distance trains is no doubt a very interesting one, but a great many trials and failures will have to be gone through before it can be practically solved.

It is quite otherwise as regards our suburban lines, particularly those round London. The decision of the Board of Trade in the case of the Metropolitan and Metropolitan District Railways will, we hope, do much to accelerate the introduction of electric traction on all our suburban lines. If companies like the South-Western, London Brighton and South Coast, South-Eastern, Great Eastern, and North London do not decide to do something in this direction shortly, they will begin to feel the very serious competition of the electric tramways and light railways which are being constructed all round them. If, on the other hand, they are wise and take the matter in hand at once, the tramways and light railways, instead of competing with them, will become their feeders.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"C. H. B." writes:—"Referring to 'St. Stephen's' question and your answer to same in your 'Legal Query Column,'* would there be any difference if the local authority held a provisional order for the supply of electrical energy for the town, but had not yet started the work in any way whatever?"

*** This very interesting corollary to the question already asked and answered in this column, describes a course of procedure on the part of local authorities which has done much injury to the progress of electricity. The question put and answered in last week's issue, page 89, was as follows:—

"We shall esteem it a favour if you can give us some information as to the powers possessed by a Corporation, that is:—Have they the power to forbid the erection of overhead wires over a street or streets for the purpose of lighting a branch establishment, by a firm having a private plant, or wishing to supply other firms from such private plant? We have an idea that it was stated in an electrical paper, the name of which we cannot recall, that such a body had not the power, but are not quite sure on the point.

"The case in point is that a large firm in ——— who have several establishments on two sides of a street are anxious to connect same by means of overhead wires, and we are anxious to know if such wires can be fixed without the permission of the Corporation.

"If you will kindly give us this information we shall be obliged."

In reply, we expressed the view that as our then correspondents were not acting under the provisions of any provisional or special Act, the local authority had no power to interfere with them. Our new correspondent asks whether the fact that the local authority are in possession of a provisional order which they have not worked, will give them further powers of interference. We are glad to be able to answer this question in the negative. A provisional order or special Act confers no monopoly upon the undertakers. The Electric Lighting Acts are permissive only: they confer certain rights, and impose certain restrictions on the company or local authority. It follows from this that they have no right to interfere with a private supply company, either by ordering them to remove overhead wires or in any other way. A company, however, who supply electricity under provisional order, must obtain the leave of the local authority if they wish to make use of overhead wires. The above opinion must be read as applying to extra-metropolitan districts. Places within the County of London are affected by the London Overhead Wires Act, 1891, which gives the County Council power to make regulations as to the use of overhead wires within the metropolis.

* See ELECTRICAL REVIEW, January 17th, 1902, p. 89.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

4,777A. "Improvements in electro-magnets." R. W. BARKER. (The Murphy Safety Third Rail Electric Company, United States.) (Date claimed under Patents Rule 19, March 6th, 1901.) January 10th. (Complete.)

333. "Improvements relating to electric lighting." R. B. LEACH. January 6th.

337. "Improvements in or relating to arc lamps." S. DE STEFANI. January 6th.

351. "Improvements in connection with electrical bells, telephones, ringing keys, contacts, switches, indicators, relays and the like." I. H. PARSONS. January 6th.

360. "Improvements in contact devices for electric railways." E. P. WETMORE. January 6th. (Complete.)

361. "Improvements in contact boxes for electric railways." W. M. BROWN. January 6th. (Complete.)

380. Improvements in contact-shoes for electric railways." W. M. BROWN. January 6th. (Complete.)

381. "Improvements in electric cables." B. J. B. MILLS. (A. Borel and C. Borel, Germany.) January 6th.

383. "Improvements in galvanic cells." E. FRIESE. January 6th. (Complete.)

416. "Improvements in self-registering time, speed and distance indicators, and automatic electric safety check." R. PAULSON. January 7th.

418. "Improvements in the construction and working of electric batteries." B. J. HALL. January 7th.

473. "Improvements in or in connection with trolleys, switches, junctions, or the like, used in connection with overhead wires for electric traction." D. B. FOSTER. January 7th.

493. "Improvements in electrical demand or rebate indicators." F. LUX, JUN., and THE REASON MANUFACTURING COMPANY, LIMITED. January 7th.

506. "Improvements in insulating secondary sections of induction coils." M. A. CODD. January 7th.

509. "Improvements in synchronous electric motors." C. W. S. CRAWLEY. January 8th.

513. "Improved trough or carrier for electric cables." W. INGHAM and B. LANGTON. January 8th.

561. "Improvements relating to electrical heating apparatus." THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, LIMITED. (J. S. Peck, K. C. Randall, and C. F. Scott, United States.) January 8th.

597. "Improvements in connection with electrical advertising lamps and the like." W. ELLICOTT and G. A. HOWITT. January 9th.

603. "Spring shade carrier for electric lampholders." H. FARRAR. January 9th.

609. "Improvements in electrical switches and cut-outs." R. F. HALL. January 9th. (Complete.)

636. "Improvements concerning electric lamps." T. TERRELL. January 9th.

654. "Improvements in fusible cut-outs for electric lighting and power circuits and the like." A. H. HUNT and J. HEWETT. January 9th.

667. "Improvements in connection with surface contact electric traction systems working with magnetically operated switches." THE DOLTER ELECTRIC TRACTION, LIMITED. (H. Dolter, France.) January 9th.

737. "Improvements in railway sleepers, brake blocks, driving pulleys, rollers, insulators for electric wires, and other similar articles." S. G. BOARD and G. F. FREEMAN. January 10th.

750. "Improvements in wireless telegraphy." S. G. BROWN. January 10th.

751. "Improvements in wireless telegraphy." S. G. BROWN. January 10th.

825. "Improved method of protecting electric cables." B. M. DRAKE and J. M. GORHAM. January 20th.

837. "Improvements in electrically-actuated devices for locking the doors of tramway, railway, and like vehicles." M. FELS, R. ZWACK, and the firm of W. BURRI. January 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

3,361. "Improvements in the manufacture of secondary batteries." J. G. Hathaway. Dated February 20th, 1900. Relates to batteries of the type described in Specification No. 2,259, of 1899, in which the positive electrode consists of a central conducting plate, to one or both sides of which is applied a mass of active material held in a rigid porous non-conducting casing. The invention consists firstly, in providing the supports with perforations which are filled with the active material; and secondly, in plates of large size which are made up of several plate elements with one central conducting plate, the porous supports being separated from each other by ribs, which project from the central conducting support, or the separation being effected by projections formed on the edges of the plates. The object of this second part of the invention is to facilitate the circulation of the electrolyte.

3,371. "Improvements in and relating to electric heaters and switches." E. F. Porter. Dated February 20th, 1900. Air-heating apparatus, consisting of electrically-heated wires and an electrically-driven fan, described in Specification No. 5,595, of 1891, in which the fan may carry the heated wires, is controlled by a switch.

3,461. "Improvements in and relating to electro-magnetic brakes." Westinghouse Brake Company. (F. C. Newell and E. M. Herr, U.S.A.) Dated February 21st, 1900. One arrangement shows an electro-magnetic rail brake, which is adapted to apply to non-magnetic wheel brakes. The core of the electro-magnet is wound with three coils of wire arranged in series in a local circuit with the motor. To ensure automatic regulation of the braking according to the speed attained, the three coils are wound with a different number of turns of wire.